FUTURE EDUCATION ROME 2017

PROCEEDINGS

2nd International Conference on Future Education

Effective Learning in an Age of Increasing Speed, Complexity and Uncertainty

Co-Organizer:

Collaborators:

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SECTION 1
INTRODUCTION

Introductory Remarks by the President of WAAS

Each one of us today has more information accessible on our cell phones than was available to all of humanity in earlier times. Yet, our education system still largely follows the model introduced at the University of Bologna in 1088, at a time when all knowledge was in the possession of a very small number of scholars, transfer of information could only be done through oral lectures, and books were hand-written and so rare that they were kept chained to library shelves.

The 2nd international conference on Future Education, held in Rome on November 16-18, 2017, recognized the need for a radical paradigm shift in the way we teach and learn in order to meet the multi-dimensional challenges confronting global society in the 21st century. It concluded that a massive quantitative extension and a radical qualitative shift in education are indispensable.

In conferences spanning the last five years, the World Academy of Art & Science has been repeatedly asking the same critical question, "If you want to create an accessible, affordable, relevant and world class system of higher education open to all human beings, how would you do it?" The founding of the World University Consortium in 2013 marked a milestone in a long search for effective answers to this question.

The Rome Conference is the second in the series which began in October 2013 at University of California at Berkeley. More than 300 speakers and participants came together in Rome to discuss important questions, formulate conclusions and practical recommendations designed to transform the educational system to enhance its reach, accessibility, quality, relevance and employability to meet human needs, fully develop human potential, and prepare today's youth for the challenges and opportunities of tomorrow.

The Rome Conference was organized by WAAS, WUC and Roma Tre University (RTU) in collaboration with the International Association of University Presidents, Kyung Hee University (Korea), Person-Centered Approach Institute (Italy), The Mother's Service Society and Global Institute for Integral Management Studies (India), InterUniversity Centre (Croatia), and others.

The uniqueness of this multi-stakeholder conference lay in the fact that it brought together eminent thinkers, researchers, university administrators, professors of education and other disciplines with representatives from the business community, labor unions, international NGOs and government. It also included large groups of students from Roma Tre University and Kyung Hee University in Seoul representing the voice of the future. Students are the consumers and beneficiaries of the educational system, whose future lives would be powerfully affected by the type and speed of evolution in the global educational system.

Heitor Gurgulino de Souza
President, World Academy of Art & Science and World University Consortium;
Former Rector of the United Nations University

Introductory Report on the 2nd International Conference on Future Education

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Half a century before the Information and Communications Technology was to bring the world under one virtual platform, the founders of WAAS sought to establish an informal world university. WAAS has identified education as vital to ushering in a paradigm change in global development. Over the past several conferences spanning the last five years, it has been asking the question "If you wanted to create an accessible, affordable, relevant and world class system of higher education open to all human beings, how would you do it?" The founding of the World University Consortium in 2013 marked a milestone in a long journey of inquiry and research in answer to the question, and the 2nd International Conference on Future Education in Rome marks another. This conference was organized by the Chair of Social Pedagogy, Department of Education of Roma Tre University in collaboration with the World Academy of Art & Science and World University Consortium, and in association with Inter-University Centre, The Person-Centered Approach Institute, Il caffe' pedagogico, United Nations Academic Impact, International Association of University Presidents, Kyung Hee University, The Mother's Service Society, Council One and Global Institute of Integral Management Studies. The sponsors were Franco Angeli, Virtus Lab and Alpes Italia.

The uniqueness of the conference lay in the fact that it gathered eminent thinkers, researchers, university administrators, and professors of education and other disciplines with vast experience covering all aspects of education together with representatives from the business community, labor unions, international NGOs and various government departments. Most importantly, it also featured student representatives, including large groups from Roma Tre University, Rome and Kyung Hee University, Seoul, South Korea.

The plenary speakers declared at the start of the conference that they have come together to ask important questions, open up discussion, come to conclusions, make recommendations and thus co-create the future. The questions that were asked were not about how to incrementally improve the existing system of education. They were about how to meet human needs, utilize more fully the human potential, and how to educate differently and better than we do today.

It takes centuries of experience to create a little history, centuries of history to create a little civilization, and *centuries of civilization to create a drop of culture. Our education is the distilled essence of all human experience, civilization and culture over millennia.* We extract the essence of all our learning, and provide it to every new generation in a concentrated, abridged form that is relevant and usable, so the next generation can start off from where the previous one has reached, and go forward. This organization of education is one of the greatest human inventions. It is the accumulative result of thousands of years of human learning and ingenuity, and innumerable educators have dedicated their lifetimes to pass on knowledge from one generation to the next. Human development worldwide owes much to the spread of education. Education as a process is also perhaps one of the most difficult things humans do. It is not enough that we know what happened in the past, remember it, construct theories around it, and pass it on. We have to understand the process of passing on the experience, this requires us to become conscious. Do we know how to do that? Do we even know the essence of our experience that we should pass on to others?

The essence of education is about human accomplishment, in every sphere of our existence. It is the essence of being happy, successful, secure, content, healthy, responsible human beings, and building effective, responsible, sustainable societies. How is our present system passing on this knowledge? This knowledge is not found as information in text books. It does not reside in scientific equations, mathematical formulas, statistics, economics, art, history or literature. These subjects are all essential. They are all of relevance to everyone at some point in their lives. But they are not central to what carries us through our lives. They do not constitute the distilled quintessence of learning from human experience or the most essential knowledge that today's youth need to cope with the challenges and avail of the opportunities of life in the 21st century.

The motive power for learning is an awakened, passionately curious mind. Questions constitute the heart of real learning. One of the questions raised in this conference was, what is worth teaching and learning? Another question posed was, in an age of information glut, how much information should students be made to seek for themselves, and how much should be taught in school? Can the time spent in the classroom not be used for better and more effective learning than simply transfer of information? Teachers have always known that we learn best when we teach others. Paradoxically, we have an education paradigm that maximizes the learning of the educators. The conference also inquired as to how we can flip the paradigm. It also inquired deeply into the process of thinking and creativity. It is easier to tell people what we know rather than to get them to think. We need a paradigm in which everyone becomes a source of learning. Is such a change practical, feasible, and if so, how can it be done?

Our schools and colleges fundamentally encourage competition. Every student is ranked against others. They largely study by themselves and compete against others. Whereas at work, the most important thing is to work as a team, cooperate, learn, discover and create together. Can we move from a system of competition to one of cooperation? Can we shift the emphasis from the subject

to the person? From passive dissemination of information to active learning?

None of these changes are easy, and no one has complete answers. We see that we live in an increasingly globalized world of unprecedented complexity and uncertainty that is changing at lightning speed. Education is the single most wonderful invention of humanity, and the single most challenging one too. We have so far shaped it by a long process of trial and error. What we have today is a result of thousands of years of learning, and it cannot be unlearnt quickly. However, when we look at the challenges, complexity and speed of change we face, it becomes clear that we need to do better than in the past. We cannot afford to improve slowly and incrementally. We need to be able to help the next generation learn and do much better than we have done so far. That was what the conference on Future Education was about.

During the conference there emerged a growing consensus of the need for a paradigm shift in education from the subject to the student; from passive absorption of information to active understanding and thinking; from academic knowledge to personality development; from abstract concepts divorced from life to richly contextual knowledge; from narrow disciplinary expertise to inter-disciplinary perspectives; from sanitized physical facts to values that foster sustained accomplishment and harmonious human relations; from individual competition to cooperative group learning; from the ability to memorize the right answer to the ability to solve problems, think independently, discover, innovate and create. Regardless of how many jobs one changes or countries one travels to, the one constant is the human individual. An education that values the person, teaches how to relate to others—as individuals, groups, societies and humanity—and work together successfully, such an education is most valuable.

Contours of the Needed Paradigm Shift in Education

Old Paradigm	New Paradigm
Subject-centered	Person-centered
Passive transfer	Active learning
Competitive individual	Collaborative group learning
Standardized competencies and Conformity	Customized, creative individuality
Information	Values
Abstract knowledge	Understanding & critical analysis
Mechanistic, reductionist thinking	Organic, integrated, interdisciplinary, & transdisciplinary thinking
Transfer of mental knowledge	Development of the whole person(ality)
Fragmented & compartmentalized knowledge	Contextual knowledge

The plenary speeches, parallel sessions, workshops and discussions at the conference were a rich and insightful examination of issues critically important to the change we need. It generated a plethora of important conclusions and recommendations for consideration by educational institutions, governments, businesses and civil society. But clearly this conference only represents a step in a much larger process. Apart from the insights, ideas, perspectives and practical recommendations generated at the conference, there are also many questions that need still to be seriously considered and researched in order to arrive at satisfactory answers in the form of solutions, policies, strategies and methods for application. Moreover, these answers are themselves only steps in the process of moving from conception to implementation, from leadership in thought to effective action. The Future Education Conference in Rome is best conceived as a step—an important meaningful step—in a wider process as WAAS and WUC attempt to establish a world university that can provide accessible, affordable, relevant and quality education to all.

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Contextual, Relational, Human-Centered Knowledge

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Our education gives us knowledge, mostly scientific knowledge, but it does not supplement it with a context or perception. This system prevents us from seeing the complete picture due to its emphasis on compartmentalization and objective facts. In such a system, our emotions, feelings, ideology, beliefs, and our organization of reality do not find a place. In reality, no issue can be understood in isolation. All issues are interdisciplinary, and can be understood only within a context and when linked to everything else. Specialization has its place, but so does inter-disciplinarity.

Sometimes the study of history reduces the individual human being to an automaton of society. Psychology may ignore society focusing exclusively on the individual. Science becomes a subject of study without reference to anything else. We need to add to all these studies the link to the human being. The human trinity includes the species, the individual, and the society, the three inseparable realities. Any of the three can be understood only in relation to the other two. This relationship must be embedded in our education.

Similarly, it has to recognize that pure reason does not exist. All humans are a mix of reason and passion. Passion without reason slips into delirium; a reason without passion tends towards rigidity. It is not possible to separate the human being from his or her beliefs—be they ethical, moral or religious. We may often seem to be solely interested in our own well-being, but we are also capable of selfless generosity. We are neither entirely rational nor entirely irrational. But some of the subjects we teach, such as Economics, ignore this truth. Education must make this aspect of our conceptual framework explicit.

Our education also witnesses a widening gap between science and the humanities. We cannot effectively address the complex problems humanity faces if we disconnect the two streams. We need to reconnect the physical and metaphysical. The contribution of literature and poetry to the formation of human consciousness is significant. Piecemeal attempts at solving problems that ignore the human context and interrelationships between issues are of no avail. Real education must equip the mind to synthesize information from many sources, understand relationships, and see the whole.

Errors and mistakes in taking decisions, managing relationships, career or politics can have great negative consequences. It may not be possible to teach an infallible method for avoiding mistakes. But it is possible to teach about the ways of thinking and ways of knowing that commonly lead to errors and illusions. To bring about these changes, a government decree is not enough. We need to implement these reforms, beginning with pilot projects. We need to supply real life experiences to students, not just information in textbooks. Correspondingly, teachers need enriching training. The role of teachers will continue to be valuable. Computers, internet, Wikipedia and Google search can supply students with information, but humans will always need human contact. Students will always benefit from the presence, the contact of the teacher. Many a student has been inspired and transformed by the teacher.

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Education to meet Societal Needs

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Our world is full of interdependent and interconnected networks, and we need to understand the system better to avoid negative outcomes. Educational institutions of the industrial age were built to train factory workers. They were never expected to be the source of innovation.

The Industrial Age is coming to an end as we recognize its fundamental disharmony with living systems on a social and ecological level and its disconnect from wider societal needs. We cannot be free of this era without making deep changes in the primary and secondary education. As John Dewey said, education is the fundamental method of social progress and reform.

We must take both an outside looking in and an inside looking out perspective, to see the mismatch between school and reality. The functionalities of the school are individualistically competitive, teacher-centric, curriculum-centric, passive, contextless and focused only on teaching technical skills like basic literacy and numeracy. These defining features of schools are imprints of the industrial age. This is irrelevant to the life of the children and the community they live in. It is at odds with the reality and results in disengaged teachers and students. We must also take the standpoint of the society to understand the problems generated by the present system.

To what extent are we satisfied with the models of civilization that we are creating and perpetuating through our education pathways? At no time in human history are children more aware of the state of the world. They understand the turmoil going on locally and globally. With unstable models of public leadership in the age of profound disruption, kids are faced with the dilemma of going down a path of education that does not fit or equip them to succeed in the emerging society in which they live.

Educational innovators are building new models with project-based, learner-centric, contextual learning that are deeply rooted in the reality of the child's life. They are bringing the focus on the development of the person.

A lot of guidance is needed to steer the process that will come from the outside looking in perspective, when schools step up to fulfil the needs of society. Harmonizing the forces for innovation internally with the imperatives for change externally is the key.

The educational model built by the IB network of schools is global and cross-cultural. It has 6000 programs around the world, helping students learn to create the world in which they want to succeed. Primary and secondary school students understand complexity and interconnectedness in global issues like water. IB network teaches to build Compassionate Systems—compassion for the self, others and the larger social system. It integrates social and emotional learning, being rooted in mindfulness and awareness.

Technology platforms are really important to democratize education, like the revolution brought by MOOCs of MIT. Technology is an enormous enabler for the innovation needed in education. It can be effectively used to foster learning communities like Teach for all, ULab, J-WEL that bring deep, lasting, ongoing innovation in global education

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SECTION 2

UNIVERSITIES REFLECTING THE CURRENT STATE OF THE SYSTEM

The European University in Crisis: A Vision From Spain

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1. Some Preliminary Considerations

1.1. Education and University

Education, from the Latin 'educatio', as defined by The Royal Academy of the Spanish Language, is the action and effect of educating, as embodied by the definition "instruction by means of teaching action". We have devoted our life to education in the spirit of providing guidance and direction to our students, to develop or make perfect their intellectual and moral faculties by means of precepts, exercises and examples. This is an arduous and at times desperate task, especially when students are educated in the University where they arrive with a ready conformed mind, with habits already acquired and with a series of mental prejudices already determined.

Those of us who profess a teaching vocation, assume in this way our commitment to the world, to the society we serve and live in. And this task, impassive and always unfinished, necessarily implies a certain distance from the world. Hence the traditional absorption of the teacher whose intellect often stays in a dimension is not yet reached by the disciple. This also results in a paradox that the task of educating, in spite of always being an exercise, requires for its preparation a certain amount of solitude, quiet work, inspiration, and withdrawal from worldly distraction and of the concupiscence of the senses. The same applies to study and in today's world so enraptured and full of distractions and stimuli, the task of the educator is more difficult, requires more capacity for abstraction, and schools need less superficial teachers, preferably an environment isolated from the disorder that rules everywhere.

University education carries with it an implication of maintaining a certain distance in order to both teach and learn. It is for this reason that true education is in its essence an enigma to utilitarianism. Traditionally, the University was understood as a community of free men seeking truth. A definition that today still seems valid and adjusted to the essence of what a university is. As truth seekers, we university people will be determined to find it, regardless of whether the truth found is useful or pleasant to the majority or whether it is to the liking of the powerful. Properly understood, university autonomy (in its applications to the institution and also in its applications to the members of the university community and especially to lecturers) is precisely the guarantee of that freedom without which any educational endeavour will be mediated, and will remain emptied of its real content and reduced to one of its dimensions, perhaps the simplest or most insubstantial.

Today we see with sadness how the University has lost much of that freedom due to the bureaucrats and governments, but not all faults of our degradation fall on the external operators of the University. The dangerous conception that the University should be useful in transmitting only the knowledge and skills necessary for employability has also spread among us. We do not doubt that the improvement of the professional and job prospects of our graduates is very important. It is what society demands from us and therefore, we will have to adequately attend to that need. But limiting the essence of the University to that end, valuing exclusively the creation and dissemination of that useful knowledge for the future employment of the student, is in our opinion a gross error of unforeseeable consequences but intuitively I can say that the consequences will be highly negative. The University must certainly contribute to the transmission of useful knowledge for employment. However, limiting the role of the University in our society exclusively to that means and curtailing its real purpose as an institution of higher education is going to invite problems.

The university student must surely be an expert in his discipline, but his role is not restricted to only that. University students should also be able to understand that their discipline applies to the whole world and should be able to develop their own ideas, to have a critical mind, to feel perpetual curiosity for everything around them, to live intensely, cultivate the yearning to know and ultimately attain intellectual expertise and constantly walk on the path of reaching it throughout their lives. Much of what is required to be a good professional must be acquired in the workplace itself and only the passage of time, one's own mistakes and those of others, as well as experiences of successes will allow one to reach professional status in its wider meaning. The University should give the graduate that initial kick start that will place him in a good positioning but, in our judgement, should not focus exclusively in preparing the student in the chosen discipline. We do not say that this is the main cause of the crisis the European University faces, but it is certainly a first symptom or effect of its increasing decay, perhaps a second cause because it feeds a sick university.

1.2. Notes on the Debate of the Public and the Private in the Heart of the University

This is the context where the traditional debate about whether the University is a public or a private good takes place and the debate extends its content to interesting issues that we may not be able to address with the necessary depth in a contribution such as the present one. The assimilation of education as public goods is obviously based on the fact that it is the entire society that benefits from it, while those who claimed that it was a private good focused on the fact that the direct beneficiary is the student and this particular benefit is of private nature. The question may seem trivial, but it is not so, given the relevance derived from its understanding as one category or another. In our view, the nature of education is mixed, public and private, since both visions are right in understanding both society as a whole and the individual as beneficiaries of education. Given this situation, we do not want

to avoid the debate on the financing of the University, on determining who and how much to pay to receive public higher education service. This is an issue that is obviously related to the previous one if we understand that the beneficiary is society and, therefore, the very nature of university education is public and so it will be society and not the individual who has to defray the expenses.

It is a question of tremendous importance that the problems of each of the national education systems are resolved in a different way. By way of example and having a greater knowledge of the Spanish reality, we will illustrate the question with Spain. The financing of the University has been, at least in Spain, one of the issues that has never been solved satisfactorily for all, perhaps because of the adverse situation our university system faces, which was once a reference in the medieval beginnings but is today simply irrelevant in the European and global framework.

Consistently and after nationalization, most of the Spanish Universities, through confiscation and honourable exceptions, have converted the prestigious Ecclesiastical University into a mediocre State University which has requested greater funds and resources to carry out the functions entrusted to it. Public Universities are subsidized mainly with public funds that come from the general State budgets through Autonomous Communities. Students pay only a small percentage of the cost of their enrolment (with or without scholarship), a cost that is not even known with scientific certainty. It seems that the knowledge of the University is insufficient to determine what a university student costs the University. This is not difficult to comprehend when we take into account that public Universities in Spain have not even been able to implement analytical accounting systems despite the fact that they are legally bound to do so. It is ironic that the clamour of the University is constant in terms of demanding more money when it is not even able to know exactly whether what it does is sustainable, efficient and convenient not only for the members of the university community but for the society which it theoretically serves.

It is beyond the scope of this work to dwell on this question, which merits a monograph. It should be pointed out that if university education has a mixed condition, that is, it benefits both society as a whole and the individual who receives it personally, and it would seem obvious that its financing should be of mixed nature in all cases, that is to say, paid by the subject that receives it and by the State that benefits from students in a University. The proportion of each party to this "co-payment" which, we insist, should be applicable to all citizens without any discrimination, would have to be logically dependent on two factors alone: the merit of each individual and their previous economic capacity. The greater the merit of the student and the lower the economic capacity of the student, the greater should be the proportion of his education covered by the State; to lower merit and greater economic capacity, less contribution should be made from the public to help students' university education. And of course, this holds true, regardless of the University (public or private) in which the student in the exercise of their freedom has decided to study. The reality of what something is, once again, is far from what it should be. In the case of Spain, only students who opt to follow their education in public Universities receive co-payment for their university studies, because in fact it is the institution that receives the money and not the particular student. Such an unjust way of financing, discriminatory and disrespectful to the freedom of choice of educational centre, is consistent with the crushing of the traditional principle of subsidiarity proper to the old European Christendom and particularly in Spain, according to the old principle *corruptio optimi pessima*. The intervention of the State and the civil society today becomes preponderant, through universities of a non-public nature, which are limited and conditioned by all possible means. A limitation that in practice is confined to mere tolerance and that too, reluctantly. We shall return to this later, but let it be said now that freedom was always necessary for the search for truth as we pointed at the beginning of this document. And because of this, freedom within the University has always been threatened by the powerful at any level at which this claim needs to be examined. At a general level, the constitutions include the freedom of foundation of universities and private schools, configuring this right as fundamental and as the first priority. In the educational environment the autonomy of the University, which is only the expression of freedom in the academic world, is also guaranteed and protected to avoid interferences that are incompatible with the search for truth. However, once again we see how post-modernism gives us examples of living contradictions and the Spanish case is also paradigmatic in this respect as we shall see later.

1.3. Crisis and the European University

Crisis means, according to the Real Academia Española in the meaning listed first, "profound change with important consequences in a process or situation or in the way in which these are appreciated". In the third meaning listed, it is a "bad or difficult situation". We exclude the other meanings because they are relevant to medicine or economy. We therefore overcome the current fashion of affirming that crisis means opportunity, which perhaps corresponds to some oriental philosophies but is not characteristic of our cultural context. In our environment, the term 'crisis' has always had a negative connotation, either because it causes uncertainty in the face of a relevant and often abrupt sudden change or because it is understood in the sense of frustration of expectations with the risk of loss.

Crisis has played a central role in the last few years in the European context. Say, the economic crisis for about ten years, the political crisis in the last five years. As far as the University is concerned, the crisis has been the ongoing state for over thirty years; since the 1980s when the American universities exceeded in capacity, notoriety, results and prestige compared to the European university system which was at that time still atomized into different national systems. Since then, Europe has tried to overcome its deep crisis. The rigid Humboldt University yielded to a much more open model after it faced a crisis. The most recent proposal is the so-called European Higher Education Area which in practice continues to suffer from an enormous amount of incoherence due to the aggregation of different national particularities. Nowadays, even a certain coherence has not been achieved in regard to the duration in years of university studies. It has even been necessary to create a homogenized supplement to the diploma obtained by

the graduates so that the essence of what has been studied, the knowledge and skills acquired can in some way be understood in the common space.

The University has never had more means at its disposal than today. Never before have there been less young Europeans and consequently, the University is less impersonal than ever before. Never before has available information resources been more at hand; the technique has been at the service of teaching and research with means. Until recently, the scenario was more typical of science fiction than an academic environment. Inter-European mobility has never been simpler and it had never been easier to attract international talent, to cooperate in multinational teams and to learn from the good practices of those who are more advanced than us in didactics, methodology or learning outcomes. And yet the European university still faces a crisis. How is it possible? What is the reason for it? We will try to answer these questions and explain the paradox that we face.

2. The Context in which the University Develops Today

2.1. Society and Globalization

As much as the paladins of postmodernity insist keenly on repeating the praises of present-day society, any minimally critical observer can understand that destroyed societies coexist currently as totally fragmented units with no other social bond than materialistic attachment and surrounded by financial conditions and wealth. In such societies a plurality of uprooted individuals separated from the firmness of values and traditions, considered as their own, unconsciously has become part of a mass phenomenon and has been absorbed by the sinkhole of the politically correct, the promotion of the plural regardless of it being good or bad for the individual and society and by a supposed tolerance that in the end hides the most adverse of tyrannies. Tyranny is demanded by enslaved subjects who are under the effects of a libertarian illusion that does not think of the common good but only in the particular good of a few.

This mental unity, of clearly totalitarian roots, dominates the West and does not refer to the accessory but to the essential. In the accessory citizens enjoy the dream of having opposing opinions, of observing political confrontation between seemingly different parties and of choosing the course of their lives. However, this globalizing and unifying system through its brands, fashions and tendencies, only distracts minds while the terrifying domination occurs and the individual, as never before in history, joyfully and gradually renounces his human essence, is degraded in his morality and is reified to become a scarecrow of himself. The techniques help this mental uniformity, keep those that are part of the mass phenomenon happy and it is also useful towards their control which affirms their superficiality. This frames a context in which superficiality and materialism are installed in society and therefore also in the University itself, spreading equally to teachers and disciplines, and thereby curtailing any possibility for the University to fulfil its true mission, restricted as it is by political correctness and in search for material returns.

2.2. Democratization of Access to University

In the above-mentioned mass-production like context, meritocracy suffers greatly and as far as university studies are concerned, egalitarianism with an uniformitarianism effect is reflected in the consideration that university studies are a fundamental right and therefore should be universally accessible. Europe understands that no one who wishes to have university studies should be excluded and to this end, it has created measures such as the elimination of access tests or their conversion into pure formality that all students go through and most of them pass. The result is far from a selection process and it rather creates mental illusions in the less prepared candidates. Egalitarianism makes universal what was previously reserved for the intellectual elite and as it is to be expected, it does so on the basis of equalization from the base. There is no doubt that some institutions that truly select their students or some others that in only certain studies can make that selection still remain. However, the general rule and more so in the public system is that in one university or another, the less prepared candidate will be able to achieve his dream of being a university student and be awarded a degree that proves his condition.

This has produced, as it cannot be otherwise, a drop in the average level and an increase in inequality among students (the more and less prepared) that hampers classroom dynamics and complicates learning and teaching dynamics making the task of the lecturer more difficult. In addition and in order to adapt to the students, it is common to reduce the level of requirements and the depth or complexity of the explained contents. As a result and objectively, the level achieved tends to be lower than it used to be. Notice that equalitarianism and mediocrity have also spread among the classrooms on the professorial side and, although in times of economic crises enrolment numbers have come down, in many cases as in the case of Spain and to refer to the example that we know best, the deadly damage to the institution has already been done, with a highly bureaucratic faculty with little scientific relevance who are more concerned with documenting their daily work than to form their own ideas with which to get their students to think.

2.3. The University Models

The university doctrine* has established that there are three models of organization of the Universities; namely, a "bureaucratic-official" model, a "business" model and a "collegial" model. None of them is perceived as pure and normally a mixture is found in the analysis of the different educational systems of the States, although the dominant tendency can be detected fairly easily. Therefore, out of the three we will reduce our analysis to two of them. Two different models, although they are not exactly subsumed in any of the previously mentioned models, contain some of their most important characteristics. Thus, for the purposes of this work, we proceed by distinguishing the "continental" model from the "Anglo-Saxon" model.

* Cfr. B.R. Clark, *The Higer Education System*, Berkeley, University of California Press, 1.983

The first one with clear collegial-like roots and medieval spirit, is the corruption the original model filtered through the sieve of statism proper to modernity. It is a model that was rich and varied in its origins and plural in unity. Today, this model is fundamentally controlled by the State in its various modern configurations. A model in which the State establishes increasingly detailed rules of operation, including planning in the most interventionist sense based on egalitarianism. Under this model, the State also finances most of the University budget, has preference for the public University and in the best of cases tolerates those Universities born out of a social initiative. Currently, everything is regulated under this model in which ironically, university autonomy remains to be identified however much it is constantly proclaimed. The model is a contrast to the old Medieval University, anchored in traditional society and therefore in its own jurisdiction was as alive as the society it served. Study plans, categories of teaching staff, promotion systems, university governance, research orientation, student admissions, teaching staff selection, relations with society... Nowadays everything is filtered through the sieve of the State in a broad sense, everything is made uniform and is regulated to guarantee the uniformity of the public educational service, thus killing any trace of assets and uniqueness proper to each individual institution. Only a memory is left of those remains of collegial government in which everything was based on the trust placed in the University that was fully sovereign within the established social order to establish and determine everything that related to its operation. An unfortunate transformation is an example of the degradation of Europe that went from being a living body in Medieval Christendom where the University was a valued reference, to today's system that is rotten. Corruption also extends to the Universities, as it could not be otherwise.

The second model, radically influenced by the Protestant ethic, is what we have come to call Anglo-Saxon. And today it has unquestionably taken the lead in practically every aspect to be measured or compared with the foul continental model. It seems logical that this is so, since as it happens with the modern State, it has a head start in its competition with the modern world with which it shares political, anthropological, philosophical and economic foundations. While the societies of continental Europe absorbed the impact of the blows of the new revolutionary paradigms of the modern State, the Anglo-Saxon world and fundamentally the United States of America and its satellite cultures were born into the new times and are therefore better adapted to the keys of modernity. This university model allows from the beginning the interaction of the new economic classes of the capitalist system with the Universities, which undoubtedly revert to a much higher financing capacity due to their agility and connection with the social demands of the productive system. From the beginning it does not start from an equal conception regarding the access to the University, but it rewards merit and capacity in a decisive way inspired by the yearning of success that characterizes protestant societies as a sign of predestination. It watches over the competition between institutions and guides them in a utilitarian way to solve the needs of leading technology and applied research, being able to afford and to devote part of its huge surpluses to basic science. And unlike the continental model it hardly has any regulations. Universities are totally free in terms of their professors and students selection, scholarship policy or internal governance, thereby making possible a University of objective quality (in fact a reference in the current world) without bureaucrats, posts in ownership or extreme politicization. A system that accounts for both terrible universities and some that are probably the best.

3. The European University in Crisis

Despite being aware that any generalization is in itself inaccurate and that any attempt at systematization is not without errors when faced with a very diverse reality, the argument that we maintain in this document is that the European University is in crisis. Perhaps it is going through its most profound crisis in almost a thousand years of the institution's history (nine hundred and twenty-eight years from the Foundation of the University of Bologna in 1,088, which is the oldest of all).

Here we offer some ideas for those who wish to know the causes of such an undeniable reality. And we point out those that appear to us to be of major relevance. We do not pretend to do, for obvious reasons of space, an exhaustive analysis. Our ideas could be contradicted dialectically, but that is precisely what we want to do by putting them in writing and taking into account that healthy intellectual debate is one of the essential pillars upon which the University should work.

3.1. Europe as a Problem

From the above argument, it is immediately apparent that in our view the European University has plunged into a deep crisis that goes beyond mere economic questions. And this is so because postmodern Europe itself is in a crisis, as newspapers remind us every day. Postmodern Europe, which leaving aside the principles that once were its support as a true civilization and destroying with revolutionary persistence the Christian society that preceded it, first promoted nationalism and then fell into a pan-Europeanism as idolatrous as it is unreal. This is based on grandiloquent declarations but not on a living society that is not able to achieve a true union because nothing really unites Europeans beyond the materialistic interest in the economic well-being achieved. Without firm values to hold on to, with no commonly recognized and accepted roots, Europe is sailing adrift without direction, becoming easily prey to superficial populisms and politicians, subjected to the increasingly fierce attacks of a sea of enemies: in the culture of American power, in Asian gigantism and finally in the social aspect, the uncontrolled migratory flows that far from being contained are encouraged by European simplistic goodness. All these enemies smell the blood of the mortally wounded and already weakened Europe and with their fashions, their money and their more or less infiltrated waves of Islamic radicalism, they deem themselves victorious. All of them are already among us, they are part of our societies and we have adopted them as fashions, investors or nationals despite the fact that they never wanted to integrate themselves into our model any more than to use our model for their own benefit. In the next few decades, we will pay very dearly for the abandonment of our true cultural roots that once made us great,

united us in morals, allowed us to stand out among other cultural, economic or military powers at that time. Rats are always the first to leave the ship when danger ensues and in our case they have decided to leave the European Union.

3.2. Lights and shadows of the European Higher Education Area

And it is in this breeding ground where the European rubbish dump opts for an initiative called European Higher Education Area, which has been aspiring since 1988 to be our lifeline in what refers to the university environment. It seems like yesterday when in that year the Magna Carta University (again a bombastic term) was signed by the vice-chancellors present in Bologna, which focused on highlighting university autonomy and on the basic structure for binomial research/teaching that always worries Universities. Ten years went by without special developments from that first statement, perhaps because the time in the University as well as in the church is often perceived and measured in centuries. But as early as 1998 the various states, as it is always the case in recent European history, take control and the ministers of education of France, Italy, the United Kingdom and Germany subscribe to the Sorbonne declaration and trigger the subsequent grandiloquent declarations: 1990 Bologna, 2001 Prague, 2003 Berlin, 2005 Bergen, 2007 London and 2009 Leuven. All of them are beautiful examples of political statements generally loaded with good wishes and little reality. The world economic crisis slows down this bunch of pretty declarations that did not do much more than to make it to pages of the newspapers. In essence, agreements with practical effect have been so ridiculous that it is embarrassing to summarize them. For example, Europeans agreed that university education divides into two cycles, degree and postgraduate. The latter being further divided into two levels, master's and doctorate. This is a great development. However, each university system decides whether the degree lasts three or four years, the master's degree lasts one or two years and the doctorate requires additional or no specific training. This way, each national university system continues to be different from one another and after so many statements and meetings, Europe still does not have a system of higher education minimally homogeneous. The reason for this is not the free choice of universities in the exercise of the autonomy that they should have, but rather the political decisions of national governments.

In honesty I will say that in all these years there has been some practical progress that has benefited the system as a whole. Only one is significant in our opinion: mobility. Europe has been able to create a successful exchange system that has favoured the internationalization of Universities through exchange stays. The name chosen for the "Erasmus" program is in memory of one of the first leaders of the so-called Free Thought, illegitimate son of the priest and his servant who was educated in devotio moderna. Together with his companions Calvin and Martin Luther, who always quoted Erasmus as a source of inspiration, Erasmus became one of the three intellectual pillars of the Protestant rupture, the first step in the revolution that would end with old Christianity. The universality of the University is not a novelty at all, but there is no doubt that the program in question has allowed many members of the university community to expand their mental boundaries knowing from within more about the reality, qualities and defects of Universities other than their own. In our judgement and beyond the successful promotion of mobility, there is little more that stands out regarding the practical excellence of the whole process.

3.3. Competencies versus Knowledge

It is an old debate to determine whether university education should try to transform those who receive it or simply limit itself to transmitting knowledge. In our opinion, the mission of the University is essentially to generate, preserve and transmit knowledge. We flee from the idealistic approach that seeks the transformation of reality to adapt it to the ideals previously determined by the intellect. We have no doubt that when knowledge is transmitted, the individual who receives it is gradually transformed, his behaviour changes, he enriches himself learning things that he did not know before and this usually results in a personal transformation. However, from there to fundamentally seek the educational task of modelling of the student's mind and its transformation for the purposes previously decided by the teacher, there is too great a leap that we prefer not to address. Learning is in our vision a process that ends up transforming the person who learns. However that implies an enrichment per se derived from its progressive nature, the need for it to be reflexive and the requirement that it be critical. We respect so much the human freedom with which God endowed our nature that we do not judge the University to choose the effect that knowledge must have on its students. Our role as academics is to guide in the learning that will most likely end with the transformation of the student. The student however must do his part and positively wish to be transformed, bringing that transformation to completion.

The previous reflection is born of the growing commitment to the strategy chosen that we have been observing in the European University, for the general and specific competencies that are geared exclusively to the future professional life. Logically, we support the training in skills or abilities but we resist supporting the exclusive aim of fitting students professionally in the work market. To reduce the mission of the University in this way seems an excessively simplistic and reductionist approach which is a sign and effect of the decline of the European University as previously mentioned in this article.

3.4. Education in what could seem to be Values but are Not

Here is another contradictory sign that characterizes Western postmodernism: the assumption and propagation of values that in reality are not values. Let me give an example. Surely, the assertion with which this paragraph begins will be unacceptable to more than one educated reader nowadays. Not for its specific content but for the previous assumption that truth does not exist and that there is not a human way and much less divine in a society that has reduced God to the private sphere, to reach it.

The assertion we make will be at best in the eyes of this hypothetical educated reader an opinion. Perhaps a respectable one but no more than any other opinion, including that which states otherwise. And if we were to take specific values it would probably

become a proscribed opinion, for only opinions that do not question the basis of the system, such as modern-day democracy or free choice of sexual orientation, are respected. Relativism has become a new dogma of postmodern faith and, as it cannot be otherwise, totalitarian root models. Either it is accepted or one is left out of the system. According to this position, relativism must be instilled in the minds of the youth since childhood and better still, at University.

We defined the University as the community of free men who seek truth, but where is the mission left within this context? It is simply left in emptiness, in irrelevance, it is non-existent. If the truth does not exist the University as we conceive of it does not make sense because its mission is impossible. It may be refuted that if there is a truth this will be exclusively scientific, testable by the method of science, which admits verification and experimentation. But in such a case, does the University only make sense when it teaches science? The urge to consider anything as science (social sciences, human sciences, communication sciences, legal sciences etc.) shows the longing for academic survival.

In order not to prolong the imaginary dialogue that we are maintaining, we will simply say that in our opinion the European University is in a crisis. This crisis is also due to the fact that it confuses the reference values as the society that the University serves is confused about them. This is the reason why the University is perceived in many cases as a simple extension of the politically correct, a place which, far from seeking the truth, seeks to formulate academic justifications against something or someone. And the university ecosystem must become a free forum in which views should be debated in an inbreeding environment where there are internal struggles for a crumb of power to break the monotony. I am in no doubt that I have been conditioned by my experience of 25 years of service in the Spanish University and the deep knowledge of the University that I have acquired and treasure throughout these years. I therefore admit that perhaps in other European surroundings the reality is not so crude. However, I suspect that in one way or another the problems we face are systemic and civilizational.

3.5. The Sophistication of the Torments around the Myth of Quality

The University system of the European Area of Higher Education has begun to traverse a path, seemingly without return, which has also been irresponsibly followed in other university contexts (we now think about what is happening in many Latin American countries). It is the way of the quest for quality. It may be a surprise that a commendable assignment is considered negative as I do. An assignment which we think is demanded by the society, a work so necessary and one that understands that the existing system was not of quality or at least not of the suitable quality. Although no one is willing to acknowledge it, the average of our Universities work in an environment of remarkable mediocrity. Let us clarify this point in order not to definitively fall into absolute discredit. By all means, the search for quality and the implementation of continuous improvement systems is a desirable asset for the University. In our view, the problem is determined by the system that Europe has decided to use for this purpose and which, as the title of the section indicates, has become a torment for lecturers, universities and the system in general with, at least in the Spanish reality that I know, absolutely insignificant results.

The European university system has made the strategic decision to seek quality through accreditation systems entrusted to political bodies and quality agencies. They are supposed to be independent, effective, expert evaluation agencies that are consistent with the designs of a system that aspires to compete among the best in a globalized world. Unfortunately, at least in the Spanish experience, we have failed unsuccessfully. At least in Spain it does not seem possible that any neutral observer can assert without failing to stick to the truth that our university system has improved, thanks to the intervention of the systems of verification and accreditation that we have been able to implement. The Spanish agency at the national level, as well as the autonomous agencies that have been carrying out their own tasks within their competence, have become bureaucratic systems that often fail to comply with the basic principles of legal certainty, independence and efficiency. These agencies, more often than is desirable, have come de facto to occupy an increasingly empty space of power, to apply political criteria in their judgments that fully invade university autonomy, to perceive their role not so much as tools to improve the system but, at best, as inspectors of the system and, at worst, as tools of the lowest passions to pay past or present personal bills, school fights or imperceptible misunderstandings. Under the apparent protection of technical discretion we find everywhere cases where the deviation of power is committed without ambiguity when not directly in brazen abuse. And the system, incomprehensibly, continues to nourish the beast created up to now without being aware of its excessive growth and the small impact on the improvement of the system itself. This is demonstrated with the objective relevant system data from all over the world showing internal and external competitiveness and the level of real improvement in short.

Most ironically, this disturbing new monster is made up of well-trained and even well-meaning professionals. Once again, the brilliant idea crumbles when put into practice through sophisticated and complex processes bringing the life of the students to a halt as they search for and prepare evidence of what is evident. The commendable work of most of his collaborators is obscured by the bad works of a few who abuse their new position of power with the terrible feeling that this is often resolved in dark corridors rather than be resolved in broad light and with scenographers. And everything is even more complex in cases such as Spain where once again, with this “provincial” complex that sometimes characterizes national initiatives, we wanted to establish controls of this nature ex ante, during and ex post with unusual and identical complexity in the different phases. This is done in order to try to appear to be at the forefront of freshness and concern for quality, when precisely in reality and stubbornly, we are placed as a system at the tail or at best in mediocrity.

Beyond the pertinence of establishing a ranking system, pertinence that we question in a university system like ours, this tool does not even exist formally in Spain. The Spanish system has an approach of coffee for all as it shows for example in the fact that a governmental initiative called “Campus of International Excellence”, which was supposed to support those exemplary experiences

of the system, has declined to recognize this excellence in practically all the initiatives presented. In practice, almost all Universities have the recognition of these Campuses of excellence in a fiction in which almost all of them turn out to be excellent. Spain has not been able to design a reliable university ranking as a system and its presence in international universities is disappointing compared to other countries in our vicinity. The Spanish university system is shielded against competitiveness, which is precisely the main engine of excellence and the financing systems hardly affect it, concerned as they are simply to make the University accessible to all citizens who wish to enroll in it. The dramatic consequence is that neither the Spanish system is a reference in anything in the world, nor the majority of Spanish university students get the fruits they expect from their passage through the University.

4. Proposals for Improvement

After a superficial analysis of the European University crisis, with special emphasis on the Spanish university system, I would like to finish this humble contribution in a constructive way. It is obvious to us that the solutions proposed will alleviate the situation and make the European university system more competitive and attractive, both for students and for academics and researchers and ultimately for the university community and society as a whole. The added difficulty of dismantling more than two hundred years of continental university history is also clear to us. We will try, however, to summarize in only five steps, the proposals for improvement through their synthetic enumeration:

I. Return as far as possible to the collegial model by undoing what has been done in the bureaucratic/official model, in the pursuit of academic cooperation and respecting the principle of subsidiarity in its classical conception. That is, favouring boundary conditions that allow Universities to develop their potential and rebuilding the public universities through professional management and a deep conceptual revision.

II. Promotion of academic freedom targeted at the search for truth and common good, thereby enhancing true university autonomy and national and international competitiveness of Universities, accompanying such initiatives with a system of access to the University in which admission depends exclusively on the criterion that each University wants to establish autonomy and discarding the universality of access that only leads to frustration among lecturers and graduates.

III. Curricular incorporation of professional knowledge and skills through non-politicized academic pensum, aimed at ensuring the mental structuring of critical thinking of the student, their ability to interact in a voluble and complex social environment, and to foster their resistance to frustration with a base of consistent values.

IV. Review of the teaching staff as a whole, of the entire teaching function, removing inbreeding from the system by establishing clear and determined systems to reward merit and ability, national and international mobility, long-term careers and the periodic and systematic evaluation of teaching and research activity through homogeneous systems that have positive and negative consequences for those evaluated.

V. Adequate budget allocation for the education system, replacing the current formula of university funding based on the number of students in order to establish a different system that guarantees freedom of choice of centre (public or non-public). The state should finance the student endowed with the capacity and willingness to study and who is accepted by the University. If desired it should also moderate the amount in regard to family income, but resulting in any case in “universal scholarship” for the university student of the public University. This would allow the approximation of the price of tuition to the real cost, with the positive implication of a requirement of greater efficiency in university spending freely decided by each institution.

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To Cope with Present and Future Catastrophic Risks, Higher Education must Train Future Decision Makers to Think Critically, Ethically and in Systems

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1. Global Risks

The World Economic Forum (2017, 2018) has issued reports on major "Global Risks" facing mankind. The Global Challenge Foundation (2017) has complemented this analysis with a considerable number of additional "Global Catastrophic Risks", both high-risk and high-likelihood.

To counteract these risks (as well as the present mounting disaffection and disruption across the world, partly due to the short-term and silo thinking of the elite experienced so far), the 193 Member States of the United Nations (United Nations, 2015) have agreed on 17 Sustainable Development Goals (SDGs) and 169 targets.

2. The 17 UN Sustainable Developments Goals

The SDGs include: no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice and strong institutions; and partnerships for the goals.

However, recent political change in Europe and elsewhere puts this hope at risk. To increase the likelihood of success for these 17 SDGs, Institutions of Higher Education world-wide must teach and train to-day's students—to-morrow's decision makers—to *think both critically and ethically, learn to cope with ethical dilemmas and apply systems thinking approaches* to serious and complex societal problems (Sternberg, 2016; Levi and Rothstein, 2018).

Students need to be aware of the local, regional and global contexts of their life and their decision making. Many of today´s students do not grasp their role in and responsibility to the world, and many don't seem to care.

A single course in college will be only the beginning. The families, media, religions, primary and secondary schools, workplaces and institutions for higher education must also be educated and recruited to do their part (cf. Summers and Cutting, 2016).

3. Critical-ethical Analysis and Systems Thinking

Briefly, then, this 2030 Agenda for Sustainable Development aims at promoting *the entire cluster* of the 17 SDGs and 169 targets.

To achieve this, critical-ethical analysis, ability and willingness to handle ethical dilemmas and apply a systems approach are indispensable prerequisites. By "critical" we refer to application of careful, exact evaluation and judgement. By "ethical" we refer to a set of principles of right conduct. By "systems" we refer to a group of interacting, interrelated, or interdependent elements forming a complex whole. Accordingly, systems thinking is based on the recognition of interconnectedness and systems processes (cf. World Economic Forum, 2017, 2018).

Critical thinking can be developed in four steps. The first—and easiest—step is to try to show that you are right. The next step is to try to show that your opponent is wrong. At this stage many stakeholders stop. But we need to go further, to the third step—to look for the truth. And, eventually, in the fourth step, to try to prove yourself wrong, and accept your original standpoint only after having failed to do so (cf. Jarrick, 2017).

4. So, What needs to be done?

The Council for Higher Education Accreditation (CHEA)/International Quality Group (CIQG) and the International Institute for Educational Planning of the United Nations Educational, Scientific and Cultural Organization (IIEP-UNESCO) have issued an advisory statement on combatting "corruption" in higher education internationally (2016). The Statement, however, uses "corruption" as a general term to designate a *broad variety of malpractices* in institutions of higher education, such as appropriation, bribery, cheating, corruption, deceit, embezzlement, extortion, favoritism, fraud, graft, harassment, nepotism, etc.—an ABC of misconduct. Accordingly, ethical thinking is based on a set of principles of *right* conduct, e.g. based on the UN Universal Declaration of Human Rights (United Nations, 1948), and/or on the UN 17 Sustainable Development Goals (United Nations, 2015).

There is no doubt that humanity badly needs an effective *implementation* of Agenda 2030, its 17 Sustainable Development Goals and its 169 targets. To make this happen, we need trustworthy, ethical, honest and impartial government institutions that exercise

public power and vary out their policies fairly. They are much more likely to promote trust and social capital which in turn improve population health and well-being.

However, all this requires critical-ethical analysis and systems thinking—abilities not particularly prevalent and accordingly in need to be taught and implemented throughout the entire life span, with higher education as a key contributor. It is crucially important that leading institutions of higher education start leading by example to increase future decision makers' motivation and ability to act accordingly.

This would be in line with the Sustainable Development Target # 4.7, namely to "ensure that all participants acquire by 2030 the knowledge and skills needed to promote sustainable development and lifestyles, including *education in human rights, gender equality, peace, nonviolence, global citizenship, appreciation of diversity, and respect for the role of culture."*

It should be obvious that this is far easier said than done. The 17 sustainable development goals and the 169 targets are rather elusive, due to their range, complexity and occasional incompatibility. They would be extremely difficult to implement—*unless* key stakeholders have been effectively trained in critical-ethical analysis and systems thinking.

5. Steps to Take

Recognizing the university sector's potential and responsibility to help shape the moral contours of society for the better, and given the societal benefits from increased social capital—we ask universities and institutions of higher education to shoulder their role as key agents of change (the Compostela Group of Universities' Poznan Declaration, 2014):

- ***Endorse a cross-faculty approach*** to broaden the curricula to include components of critical-ethical analysis and systems thinking.
- ***Appreciate the unique opportunity to shape professional identities.*** At universities, the norms and boundaries of acceptable behavior are to a large extent set for a number of professions. Universities have a possibility as well as a responsibility to help shape the normative contours of society for the better.
- ***Teach the teachers***. Provide pedagogical resources and training to a wide range of faculty, in order to encourage the incorporation of issues of critical-ethical analysis and systems thinking within their classes.
- ***Develop a webpage*** for information dissemination of pedagogical material, discussion topics, case studies collection, eLearning-tools etc.
- ***Organize conferences*** to exchange good practices as regards implementation of the 17 SDGs and 169 targets of the UN Agenda 2030.
- ***Develop partnerships*** with other universities, networks, national authorities for higher education, civil society organizations championing the critical-ethical agenda.
- ***Commit for the long-run.*** Changing norms and their consequent behavior is an inherently slow process. While there may indeed be ripple-effects from promoting critical-ethical behavior and systems thinking, it is likely that the "exposed" generation will need to reach a critical mass and/or managerial positions before true and measurable change will occur.
- ***Coordinate with national education authorities and social partners*** on the fulfillment of the state's obligation under the UN Agenda 2030 SDGs.
- ***Encourage voluntary associations*** and participation in these.
- ***Talk the talk and walk the walk.*** In addition to educating critical-ethical behavior and promoting systems thinking, it is crucial that institutions for higher education—as agents providing public goods—themselves act accordingly, ensuring impartiality in teaching, student assessment and research, and that matters regarding awards of degrees, employment and promotions are based on legitimate, transparent and objective criteria.

6. Low Costs, High Gain

Considering the relative low costs of implementation and the possible societal gains, if implemented broadly, in the long term this initiative has the potential of being extremely cost efficient. More importantly, however, is that ethically, it is likely the right thing to do.

This is why we propose a high-level conference on such issues, with a focus on the implementation of Agenda 2030 (what should be taught, and how). Based on its outcome, recommendations should be made regarding the necessary redesign of all higher education and for its subsequent implementation.

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The Knowledge of Complexity should be a part of Contemporary Education

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Abstract

In order to be prepared to face the challenges of the global world, contemporary education should include the knowledge about the complexity of the world. The basis for understanding complexity is to recognize that everything around us is made of interconnected and interdependent elements (individuals, pieces) depending on the scale. In general, it is impossible to predict the properties of a system by simply summarizing the properties of single elements. The interrelations promote and inhibit the properties of and changes in systems. In this paper the complexity of physical systems is briefly described and then attention is turned to complex thinking. The basic knowledge about complex systems has revealed many essential properties: the importance of simple but repetitive rules, the importance of non-linearities, sensitivity to initial conditions, the possibility of self-organisation, the existence of networks, etc. There are many simple and brilliant examples which illustrate the behaviour of complex systems like small world, sand piles, the butterfly effect, birds in flight, emergence of chaotic motion, etc. that do not need complicated mathematics but demonstrate the richness of the world in unexpected ways. It is argued that contemporary education should include descriptions of such simple models which form a set of cornerstones for understanding more complicated phenomena and functioning of the world. The educators should pay more attention to primers in complexity for preparing pupils not only along traditional fragmented disciplines but also generalizations. This will help next generations to manage future challenges.

We need to deeply reform all our ways of knowing and thinking

– Edgar Morin (2006)

1. Introduction

The World around us is complex which in a nutshell means that it cannot be understood only by analyzing its constituents whatever they are, physical entities or living organisms. The notion "*complexus*" itself means what is woven together and this togetherness makes the world not only richer but much more interesting. During the last half century much attention is paid to analyzing complex systems including the physical, biological, societal phenomena and explaining the ideas of complexity from the philosophical viewpoint. Sometimes the notion "complexity science" is used. According to Roger Lewin (1993), "*Complexity science offers a way of going beyond the limits of reductionism, because it understands that much of the world is not machine-like and comprehensible through a cataloging of its parts; but consists instead mostly organic and holistic systems that are difficult to comprehend by traditional scientific analysis".* An extremely important question is how these understandings are reflected in the educational system.

In this paper a brief explanation is given about the importance of complex systems together with ideas as to how the knowledge on complex systems could be introduced to educational system(s). In Section 2 general principles of complexity in physical systems are described which form a good basis for understanding complexity. Next, in Section 3, philosophical questions related to complex thinking are briefly analyzed. Section 4 includes some ideas about education of complex systems. General conclusions are presented in Section 5.

2. Complexity as understood in physics

Classical research aims to split up general problems into their simpler components and then to study them as deeply as possible. An extremely impressive explanation is given by Alvin Toffler (1984): "*One of the most highly developed skills in contemporary Western civilization is dissection: the split-up of problems into their smallest possible components. We are good at it. So good, we often forget to put the pieces back together again."* Such an understanding is changed in the scientific world although in everyday life, the simplifications as Toffler has warned, are still widely used.

The essence of complexity in physical systems is described in many monographs (Nicolis and Nicolis, 2007; Érdi, 2008; etc.) and for the encyclopaedic overview one should consult the "Encyclopaedia of Non-linear Science" (Scott, 2005). What follows is a brief survey of main effects which are important for understanding complexity (Weiler and Engelbrecht, 2013):

i. non-additivity and non-linear interactions. This is the source of chaotic motions and typical of many physical systems modelled by mappings or differential equations. A typical example of a non-linear interaction is the gravitational force between different masses. The three-body system (Sun, Earth, Moon) analyzed by H. Poincaré already more than a century ago has revealed ideas of possible instabilities. Another iconic example is the Lorenz attractor describing simplified atmospheric motion using the system of three non-linear differential equations.

ii. deterministic unpredictability. The behaviour of deterministic non-linear systems may not be predicted and lead to the *chaotic regimes* of motion. A typical example is a simple logistic equation (mapping) derived for calculation of changes in the number of species. The weather is described by the non-linear Navier-Stokes equations that again do not permit accurate forecasts for longer periods.

iii. sensitivity to initial conditions. Small changes in initial conditions for a dynamic non-linear process may lead to large changes in resulting quantities in the course of time. This phenomenon within the framework of a non-linear simple model was discovered by Lorenz although Maxwell already hinted to such a possibility in the 19th century and Poincaré, in the beginning of the 20th century. As far as the accuracy of physical quantities is limited in their value, there exists a so-called *predictability horizon* (Lighthill, 1986) because for example one simply cannot determine the temperature distributions needed for long-term weather forecasts with the accuracy of many digits after comma.

iv. there are several typical phenomena characterizing the behaviour of non-linear systems like *bifurcations* when the new solutions emerge after small changes of control parameters, *emergence* when new patterns arise at the system level not predicted by fundamental proprieties of the system's constituents; *attractors* where the solutions are attracted to a certain space of variables (phase space), *multiple equilibria* which are characterized by several (co-existing) attractors, *thresholds* which mark the borders between the various states, *coherent states* where effects are balanced, *adaptability* when independent constituents interact changing their behaviors in reaction to those of others, and adapting to a changing environment; *self-organizing criticality* when a complex system may possess a self-organizing attractor state that has an inherent potential for abrupt transitions of a wide range of intensities while the magnitude of the next transition is unpredictable, phase transitions, etc.

v. despite the variety of chaotic motions, there are several rules which govern the processes (see Scott, 2005): period doubling and Feigenbaum numbers, power laws, self-similarity, fractality of attractors, etc. and also a number of methods which allow analysis of the processes: Melnikov method, renormalization method, determination of the Kolmogorov entropy and Lyapunov exponents for determining the scale of chaotic motions, etc.

Next, from phenomena and properties one should turn their attention to structures. The main structural cornerstones of a complex world and processes are *fractals, networks*, and *hierarchies*. A brief but sufficient description of these structures is given by Engelbrecht (2016) and here we follow this description. The word "fractal" was coined by B. B. Mandelbrot (1975) using the Latin *"frāctus"* (broken or fractured) for describing irregular non-differentiable structures. The famous Mandelbrot fractal is generated by a quadratic mapping in the complex plane and possesses a wonderful property—self-similarity. In simple words, under various degrees of amplification (zooming), each small part of this fractal replicates the structure of the whole. It means that such objects are scale-invariant and in addition are characterized by non-integer (fractional) dimensions. The fractal geometry (Peitgen et al., 1992) is based on the idea of using feedback procedures that are simple repetitive rules for constructing very complicated structures. The iconic fractals named after Mandelbrot, Koch, Sierpinski, Cantor, Barnsley, etc. display explicitly the properties of fractals. The fields of using fractals for describing physical phenomena cover a wide area of nature and technology: from coastlines to crystals, from describing attractors in phase spaces to Brownian motion, from fractals in biology to structures of time-series of financial markets, from characteristics of seismic activity to music, from mountain ranges and structure of lightning to heart rate, etc.

The lesson to be remembered is that the repetitive usage of simple rules generates complicated objects which possess some universal rules.

Another important notion is networks. In simple words, a network is formed by a large set of elements (nodes) which are connected through a pattern of different interactions (links). The world is full of networks: the ecosystems form networks and webs of species, our computers are linked to the Internet or connected to cloud computing, the public transportation system forms a network starting from local connections to intercontinental flights, economics and electric grids form a global network, social networks unite persons, etc. Again, there are several universal rules which help to understand life in global networks (Barabasi and Frangos, 2014; Caldarelli and Catanzaro, 2015). A powerful tool for describing networks is the graph theory which started with the problem of crossing Königsberg's bridges. L. Euler showed in the 18th century that given the number of bridges, it is impossible to walk over all the 7 bridges only once. Nowadays we know much more about the structure and behaviour of networks. Despite the large number of nodes and links, a small world phenomenon exists with only six degrees of separation. Networks are in general terms stable and large networks do not usually break under the failure of one node or link but in some cases domino effects and cascading failures occur. The cases of failure of electric grids are known as warning examples with large-scale effects. The power law governs the network structure but not as an ideal rule because in reality the power-law might have "fat tails". There are certain limits in networks, in social systems for example, the Dunbar number (which is estimated around 150) limits the number of possible active social relations. The Matthew effect (the rich get richer) seems to be important not only in economics but also in science where attention is given preferably to known names (to Nobelists, for example).

An important notion in the analysis of physical systems is related to scales. Just remember the large-scale structure of the Universe and the nanoscales in contemporary technology. That is why hierarchies are of importance. The general definition says that a hierarchy is an organizational structure where the constituents are ranked according to some principle: the level of importance, scale or other properties. Usually related to social systems, hierarchies are also used for the modelling of physical systems, where processes at different levels having different scales are described by different models (equations) which are coupled into the general system (Engelbrecht, 2015).

To sum up, complex physical systems are pretty well described but intensive studies are in progress.

3. Complex thinking

Society is a complex social system. In terms of notions described in Section 2 for physical systems social systems can also be

modelled by networks and clusters, communities and alliances and are spatially and temporally differentiated. Society is able to function not only because of its structures but the behaviour of its members (constituents is physical sense) and links (interactions in physical sense) between them play the most important role. Turning to complexity of physical systems (Section 2), the interactions between the constituents are described by physical laws that can be measured at least with certain accuracy. In complex social systems the situation is much more complicated because the links are based on accepted rules (laws), traditions, language, and governance, on economic and environmental conditions and certainly on values. The basic question in social systems is how the members of the society (humans) actually understand and interpret societal problems. According to Scott Page (2010), "*...physical and computational measures of complexity exist in abundance. These can provide a starting point for creating social complexity metrics, but they need refinement for the simple reason that electrons don't think".*

Indeed, philosophy needs to introduce "complex thinking". Such thinking owes much to the French philosopher Edgar Morin who has studied complexity from an epistemological viewpoint (see for example, Morin, 2007; also Morin, 2006). The main ideas of Morin are described in a monumental collection of his studies in 6 volumes (Morin, 1977-2004).

As stated in the Didactic Encyclopedia (2015), complex thought "*refers to the ability to interconnect different dimensions of reality. ... Complex thought is therefore a strategy or a way of thinking which intends holistic phenomena but which, at the same time recognises the specificity of the parties. ... Everything that concerns complex thinking is related to epistemology".* Many scholars have followed the ideas of Morin (Schlindwein and Ison, 2004; Ferrera, 2010; Loubser, 2014; Malaina, 2015; etc.). Morin himself has summarized his idea in a brilliant paper (Morin, 2006) as follows. Classical science has rejected complexity because of three principles followed in research: universal determinism (Laplace's Daemon), reduction and disjunction. However, note that Morin does not mention the early ideas of oriental thinking. The importance of the second law of thermodynamics is stressed which means irreversibility of processes. Then quite logically, the problems of order, disorder and organization appeared and needed more attention because of the possible emergence of new systems which could also involve chaos. Now Morin makes a distinction between restricted and general complexities. He calls as "restricted complexity" all these results of research on the complexity of physical systems described above in Section 2 involving chaos theory, unpredictability, fractal concepts, etc. As a philosopher, Morin is keen to speak in terms of "general complexity" and thinks of complexity epistemologically. These two notions are actually the sides of the same coin and both sides need to be studied. I do not agree with Morin that "restricted complexity" is limited and still remains within the epistemology of classical science (Morin, 2006, p6) and the paradigm of classical science is only "fissured", i.e. cracked. I agree that complexity questions in "restricted complexity" are not studied with such philosophical deepness but the general mindset of scientists has clearly changed over the last few decades. Contrary to Mori's thought (2006, p21), complexity as it is understood nowadays by many is related not only to physical sciences or biology (i.e. to restricted complexity) but concerns also human beings, individuals, societal groups, etc. Some examples are given by Weiler and Engelbrecht (2013) concerning policymakers, economists etc.

Certainly, the well-known maxim "*the whole is greater than the sum of its parts*" (attributed to Aristotle) serves the understandings of the society well. Morin adds that the whole is less than the sum of its parts. Indeed, "*a certain number of qualities and properties in the parts can be inhibited by the organization of the whole*". He himself cites Pascal: "*one cannot know the parts if the whole is not known, but one cannot know the whole if the parts are not known*". And then Morin comes to the hologrammic principle: "*not only a part is inside a whole but also the whole is inside the part*". He stresses the importance of feedback, relations between local and global, and what is very important—the link between science and philosophy. Morin has strongly advocated that we have to raise the concept of system (and complexity) from the theoretical level to the *paradigmatic level.*

The philosophical framework for understanding complex systems was intensively studied also by Paul Cilliers (1998). It is interesting to follow his characteristics of complex systems compared to physical explanations (see Section 2). Cilliers (1998, pp 3-5) offers the following list: (i) complex systems consist of a large number of elements; (ii) a large number of elements are necessary but not sufficient; interactions can be either physical or the transference of information; (iii) the interaction is fairly rich; (iv) the interactions are non-linear and non-linearity guarantees that small causes can have large results, and vice versa; (v) the interactions usually have a fairly short range; (vi) there are loops in the interactions (feedback); (vii) complex systems are usually open systems; (viii) complex systems operate under conditions far from equilibrium; (ix) complex systems have a history; (x) each element in the system is ignorant of the behaviour of the system as a whole; complexity is the result of a rich interaction of simple elements. He uses these characteristics later for describing economic systems. Then Cilliers comes to the storing of information and the development of the internal structure, i.e. self-organisation. The next natural step in describing complexity is modelling where Cilliers distinguishes rule-based and connectionist models. Much attention is devoted to self-organisation and his definition grasps all the needed qualities: "*The capacity for self-organisation is a property of complex systems which enables them to develop or change internal structure spontaneously and adoptively in order to cope with, or manipulate, their environment*". Finally Cilliers comes to the postmodern society describing it as a complex system using the characteristics listed above. Later (Cilliers, 2001) turns his attention to boundaries, hierarchies and networks in complex systems.

Comparing the characteristics of complex systems listed in Section 2 (issues (i)-(v)) and above (issues (i)-(x)) it can be concluded that in physical systems much attention is based on phenomena which could take place in complex systems and to possible quantification of those phenomena. If we follow Cilliers in his philosophical presentation then the attention is on interactions. An excellent analysis of such an approach is made by Spurrett (1999). He points out that Cilliers (1998) claims that "*chaos theory, and especially the notion of deterministic chaos and universality, does not really help us to understand the dynamics of complex systems*". This is based on Cilliers' understanding that model cases of chaos are based on comparatively small number of elements (degrees of freedom) while usually complex systems have a large number of elements. Like Spurrett, I cannot agree with this

statement. Physical modelling can start from a huge number of elements all described by their governing equations. The usual way is to transfer these models to the continuum approach and the final governing equations are then partial differential equations. Such an approach helps us to understand predictability and determinism in large systems (cf weather forecast). Cilliers also mentions ethics in complex systems (Cilliers, 1998, p 136-140) but in my view, although extremely important, this problem will need much more studies rather than arguing about leading principles in complex systems. One can certainly agree with the philosophy of "*Respecting otherness and difference as values themselves*".

Actually Knyazeva (2004) explains the philosophical sense of the concept of non-linearity which is crucial to complex systems. She states that evolution in a non-linear system includes (i) the idea of multiplicity of evolutionary paths; (ii) the idea of choice between these paths; (iii) the idea of tempo of evolution; (iv) the idea of irreversibility of evolution. In this way she demonstrates by several examples that complexity is really a multi-faceted phenomenon in the universe and formulates the principles of complex non-linear thinking. It is worthwhile to list these principles: (i) the constructive role of chaos in evolution; (ii) the elements of pre-determination in the field of multiple evolutionary paths, (iii) the laws of very fast, avalanche-like processes in complex systems; (iv) the existence in changing rhythms and regimes of evolutionary processes; (v) the patterns of constructing complex totalities from simpler elements. Based on these understandings of evolution and self-organization, Knyazeva (2004) formulates the principles of soft management of non-linear complex systems. The self-control and evolutionary prohibition rules together with topologically correctly organized perturbations upon complex systems are the keywords for the system to be developed in an appropriate way. In this Knyazeva (2004) shows the way how knowledge on complex systems can lead to applications.

Clearly understanding from the physical fields of science which explain phenomena and from philosophy which explains senses are mutually illuminating.

4. On Education

The present understandings as briefly described above very clearly demonstrate complexity and globalization of the world. In order to be prepared to face the challenges of the fast changing global world, contemporary education should also include knowledge about the complexity of the world. Actually one should distinguish two main issues in education: first, education is a complex system itself and second, disseminating knowledge about complex systems.

In general terms, the ideas of changes in educational curricula are collected in a UNESCO paper (Morin, 1999). Among other proposals a major problem is underlined as to "*how we can encourage a way of learning that is able to grasp general, fundamental problems and insert partial, circumscribed knowledge within them*." It is also stressed that "*we should teach methods of grasping mutual relations and reciprocal influences between parts and the whole of the complex world*". This means clearly the changes in the educational system itself. Applying ideas of complex systems in education lead to many implications (Jacobson and Wilensky, 2006). These implications include cognitive issues, curricular contents, pedagogical research on learning complex systems ideas, etc. It looks like we have recognised education as a complex system (Jörg et al., 2007).

Leaving this important issue about restructuring the science of learning as a complex system, let us discuss the second issue—how to disseminate knowledge about complex systems.

In principle, there are two possibilities to introduce new knowledge: either to start from a very general knowledge within the framework of philosophical thinking and then move on to examples or to start from simple examples and then move on to philosophical generalisations. I strongly support gaining knowledge from simple examples which include nowadays brilliant, even iconic cases related to everyday life.

At the level of beginners or at the primary level of education, the descriptions of examples cannot use sophisticated mathematics. In what follows, several examples or problems are described which could form a basis for teaching complex systems in secondary schools. Actually even the solution of a usual quadratic equation could serve as a step for raising the problem of multiple solutions.

The first example is based on building a simple sequence of numbers

$$x_0, x_1, x_2, x_3, \dots , x_n, x_{n+1}, \dots .$$

Let us assume that every $x_{n+1} = f(x_n)$ which means that for given function $f(x_n)$ and knowing x_n we can calculate x_{n+1}. Let now

$$f(x_n) = \lambda x_n (1- x_n),$$

where λ is a constant. Such a simple non-linear model is used for predicting the growth of populations. It has remarkable properties—depending on the value of λ it can describe a chaotic regime. In other words, the number of members of a population cannot be predicted. This model, called the logistic equation is an iconic model of chaos, describes bifurcations (abrupt changes of the character of the sequence), periodic doubling (repeating the same sequence after 2, 4, 8 with different values), emergence of chaos starting from $\lambda > 3.569945...$, self-similarity (repeating the same sequence at a different scale), etc. Much can be studied from this example (see for example, Peitgen et al., 1992) including the universality in chaotic regimes.

Next example: how to construct a snowflake. Take a simple triangle as basis and divide each side into three parts, then remove the central part and build a smaller triangle to close the gap. Repeat such a procedure n times and you get a snowflake called after the Swedish mathematician H. van Koch. This might be the first introduction to fractals (see also Section 2). The famous Mandelbrot

fractal needs a little bit more complicated rules (Mandelbrot, 1975) to be followed but the resulting "gingerbread man" has opened the eyes of many researchers about the richness of fractals for their self-similarity properties. Methods for constructing different fractals are given by Peitgen et al. (1992). They have proposed simple algorithms called deterministic iterated function systems (IFS), which function as a "machine". The ISF needs an input image, several lenses which reduce the input image by setting a reduction factor and then a configuration of lens for the assembly of copies. Again, like for the Koch snowflake, the procedures must be repeated, so the feedback idea is used. The results are marvellous fractals including Barnsley fern, Cantor maze, dragons, etc. Here the programming skills are useful but this is not the problem in schools. An interesting problem related to fractality is measuring the length of the coastlines which besides its practical importance also has certain cognitive value.

Then let us discuss how to build a sand-pile (Bak, 1997). Just let sand flow from your palm to a flat surface. A pile will be formed and the more sand you add, the steeper the pile becomes. Then avalanches start to slide down the pile surface and an interesting problem is to guess where the next avalanche starts and whether it reaches the flat surface. It is not an easy task but Bak (1997) was able to find some regularities and patterns in this, let us say such "childish" problems are useful for predicting earthquakes, landslides, traffic jams, etc. Used as a metaphor, this example is rather useful to demonstrate that the laws of physics are simple but nature is complex.

Finally, one more simple example—let us look at the flocking of birds (Reynolds, 1987). This is a paradigmatic example of self-organised collective behaviour. The rules governing a flock and keeping a distance from neighbours are simple indeed: (i) separation—avoid crowding neighbours meaning a short range repulsion; (ii) alignment—steer towards the average heading of neighbours; (iii) steer towards the average position (centre of mass) of neighbours meaning the long range attraction. Again, the skill of programming helps to model such behaviour but is easily realisable. This model explains not only the flocking behaviour of birds but also the shoaling behaviour of fish, the swarming behaviour of insects, and the herd behaviour of land animals. The beautiful images of flocks and swarms could certainly raise the interest to such complex behaviour. The flock-like behaviour of humans when drawn to a focal point (entrance or exit) or escaping (from gunfire) can also be modelled similarly. Even physics of condensed matter can use the results of this analysis.

The list of simple examples is certainly longer and depends on the level of students. The goal of education should be introducing such simple notions into curricula in order to prepare pupils' mindset for more complicated analysis. Advanced level graduate courses, besides more complicated examples, should also involve techniques for analysis (Nicolis and Nicolis, 2007; Érdi, 2008; Scott, 2005). The modelling is based on differential equations and mappings and the space of state variables is sometimes more informative than the usual time-series. The analysis involves stability of solutions, constructing the power spectrum for solutions, reducing the very high-dimensional systems to systems with a smaller degree of freedom, scenarios for the onset of chaos, emergence of patterns and ensembles in nature, etc. The list of applications is extremely long: weather predictions, percolations, heart dynamics, mechanisms of turbulence, phase transitions, forest fires, cellular growth, economy and much more, even music. These applications demonstrate not only the utility and transdisciplinarity but also the beauty of the complexity of world. From the description of complexity in physical systems (Section 2), an important property of non-linear systems should be stressed once more—sensitivity to small changes in initial conditions. Either used in its direct way or as a metaphor, this property has many consequences even without mathematical models.

With such knowledge on non-linear complex systems, further courses on complex thinking could generalize the understanding in all fields of human activities, especially social systems. This should also be a part of contemporary education. However, introducing examples of non-linear complex systems, one should be aware of difficulties in the teaching process (Jacobson and Wilensky, 2006), like problems of inappropriate proportional reasoning, randomness-determinism confusion, anticipation of emergence of new structures, etc. The ideas of improving science education in general have already been flourishing for some time. For example, Lederman (2001) calls for restructuring curricula in high schools. He notes also difficulties like the willingness of teachers to change what and how they teach, the willingness of institutions to change their policy, etc. And certainly it means also increased costs of teaching because of training the teachers, preparing new curricula, preparing and publishing new materials, etc. The leading motto of changes could be along Lederman (2001) "*to marry the physical and biological universes with the wisdom of humanities and with the essential creativity of art, music, and literature".*

5. Final remarks

In the report of LERU on future universities (Boulton and Lucas, 2008), it is said that universities should develop "*the thinking and the mental and conceptual skills and habits that equip their graduates to adapt to change and even steer it if circumstances permit*". That is why we have to teach about the complexity of the world and how it is related to numerous problems: climate change, economy, energy, agriculture, policy, etc. (see Weiler and Engelbrecht, 2013). Examples of application include the analysis of predictability in policymaking (OECD, 2009), economic complexity (Caldarelli et al., 2012), network analysis (Barabasi and Frangos, 2014), etc.

The courses on complexity are often based on courses on non-linear dynamics and are in the curricula of many universities. This experience should be used more widely. However, educators should pay more attention to primers in complexity for preparing pupils in schools not only in traditional fragmented disciplines but also in generalizations. This will help next generations to manage future challenges. An excellent example is the publication series of the Publishing House POLE for disseminating knowledge on mathematics (see Initiation aux Systèmes Dynamiques, 1998). And certainly, the teaching of complex phenomena and methods for

their analysis should be united with complex thinking. Educated, competent people can influence societal changes through their action and messages by combining knowledge from unrelated disciplines and their expertise. It is a challenge to create the holistic mindset for future generations.

The monumental collection of ideas on complexity is presented by Meyers (2009) but one should also add the philosophical analysis of complexity (Hooker, 2011). Hopefully soon we could add the overview on complexity in education.

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SECTION 3

THE NEED FOR A NEW PARADIGM

Some Reflections on the Future of Education

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Abstract

Far from offering a tentative structured theory or solution regarding the urgently needed reforms concerning education in the 21st century, we limit ourselves to some punctual considerations of how education can prepare students for the future. Even if they are not directly connected, we hope they may help in creating the indispensable radical paradigm shift in the way we teach and learn, which is needed to meet the multi-dimensional challenges confronting global society in the 21st century. They involve the following points: an attitudinal change from memorizing to understanding; openness to the internet requirements of the present 4th Industrial Revolution; and developing a connection to Nature and our inner Self or essence, so students can get guidance in their lives and also to help find solutions for the many problems humanity faces today.

1. Attitudinal Change

By undertaking higher studies, many students aim for obtaining a career so as to become leaders in their chosen field. This warrants the ability to find and use the most up-to-date information and knowledge concerning their specialty. Therefore, a new human orientated model of education based on each student's needs and abilities has to be offered.

The first step towards achieving this involves an attitudinal change in the way we teach and learn in schools. In the "**traditional paradigm**" known as the "standard model" by the Organisation for Economic Cooperation and Development (OECD), memorizing of facts by repetition and regurgitation of sentences read in a textbook was a priority. Contents were learned by memory, which was understood as an act of storage that exclusively relied on repetition. This approach was based on a passive model of learning where the teacher was the only source of information, the supreme referent. Neither the autonomy of the pupils nor their diverse natures were considered. Consequently, many educative problems arose. Nowadays, nearly everybody accepts that purely memorizing information is a bridge to nowhere.

At the turn of the 20th century, there was a swing towards the opposite extreme into what was known as the "**modern paradigm**", **or** "**new education**", a term coined by Edmund Demolin (1898), who in 1921 founded the International League of New Schools. One of its most well-known manifestations was the libertarian pedagogy, probably best exemplified by the Summerhill School, which was founded by Alexander Neill. In this school, the idea of freedom of the student was carried to an extreme: children should not be obliged to attend school nor to study: they need to be left to go their own way and in this way learn what interests them (Neill, 2010), because any imposed obligation was felt to lead to "castration" (Dolto, 1985). According to this libertarian approach, self-esteem is obtained based on what the child feels, rather than what he or she does. A study of Didier Pleux (2006) shows many weaknesses regarding a model like this, that is based on learning *processes, but not on contents based on memorizing.* This assertion seems to be neurologically disparate, because memory is the main learning tool used by our brains for understanding. No wonder this modern paradigm is now being challenged (Marina, 2017a).

We therefore have to look for a new **shift in paradigm** for the education of the future. But how do we decide what to choose within the avalanche of concepts, theories and educational approaches that José Antonio Marina (2017b) graphically calls *The Pedagogic Forest*? Present pedagogic efforts for solving problems create a certain confusion, because they do not seem able to offer the right solutions, in spite of the proliferation of suggested innovations, which, we have to admit, are not always so well-grounded.

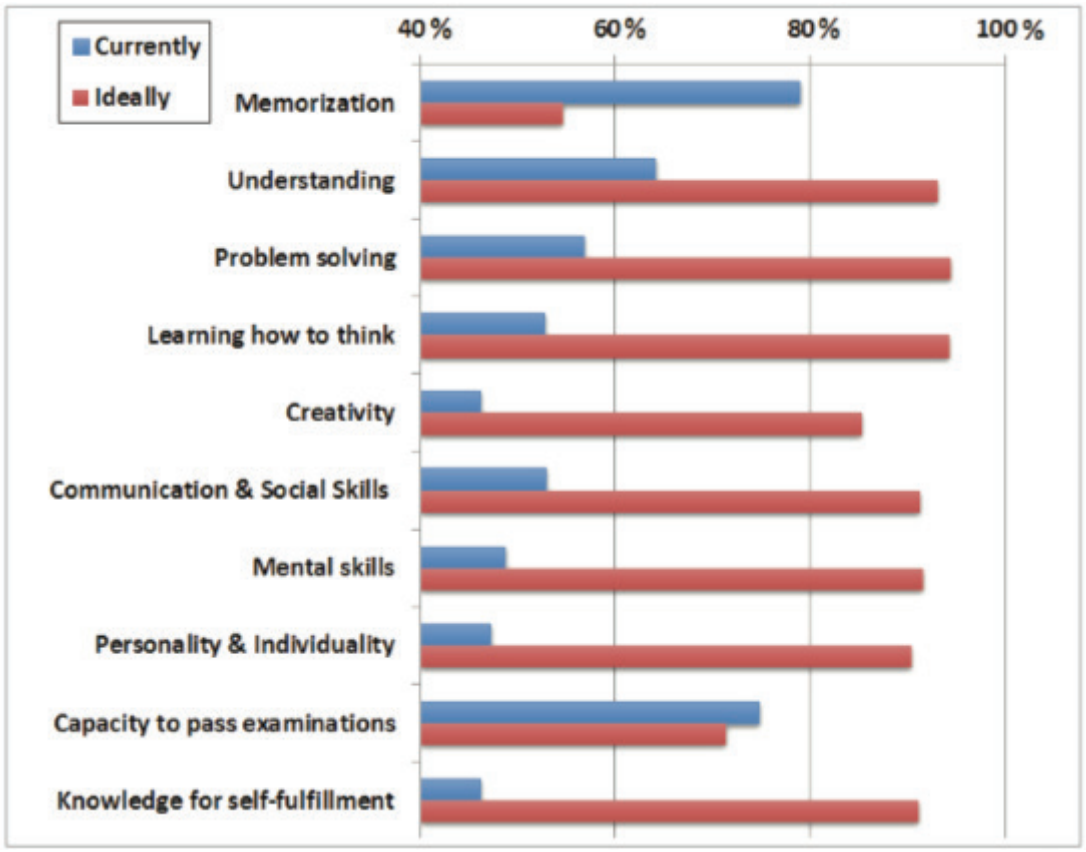
These days we need to gain a more complete understanding of subjects based on fundamental conceptual knowledge, plus new ideas arising from neurosciences, developmental psychology, anthropology... It is important to focus on skills in retrieving information from where it is stored, aptitudes involved in starting a business, leading a team, approaching problems creatively, and thinking strategically. These attributes rely on "elaboration, reasoning, intrinsic motivation, and critical thinking". As these also trump straight knowledge, Andreas Schleicher, Education Director of OECD and creator of the Program for International Assessment (PISA), feels they need to be recognized and acknowledged (Aaronovitch, 2017).

Many years ago, Karl Popper (1934) pointed out that the solution to problems is more essential than just studying topics or disciplines: "we do not study topics, but problems". The main goal therefore should not be to acquire information—especially as knowledge is constantly increasing and being updated—rather the focus should be on understanding. This is not the same thing, as suggested by neuroscience's favorite analogy in comparing the brain to a computer. Like brains, computers process information by shuffling electricity around complicated circuits. However, unlike the workings of brains, the circuits of computers are understood at every level (Pribram and Ramirez, 1980). Analytical approaches in neuroscience, when used naïvely, may fall short of producing a meaningful understanding of neural systems, regardless of the amount of data (Jonas and Kording, 2017).

Consequently, future education has to shift from an educational approach that is based on standardized models to one open to all kinds of intelligence and adapts to the personalized experiences and requirements of each human being. In this way, ALL of his or her personal capabilities can be improved, especially when they are accompanied by a flexibility in attitudes when faced with an ever-changing environment. In a few words, the implication of this in this 21st century human-centered era is that education does not specifically address the quantity **of information but the quality of understanding**. This needs to be adapted to the diverse capabilities of each individual, and should be centered on increasing creativity, empathy and leadership. The aim of education should be in providing students with a sort of compass, **a GPS, to navigate through the unknown**, as Schleicher expressed so graphically (15.09.2017, cited by Aaronovitch, 2017).

After presenting our report on this topic in the international conference on Future Education in Rome in November 2017, it was rewarding to realize that most of our above mentioned suggestions, were shared by a WAAS-WUC survey of students from diverse parts of the world (South Korea, Europe, Middle East, USA), when it attempted to identify the main topics of exploration and implementation for a future education program. The ideas they proposed at the conference (Isaković, 2017), included: a decrease in memorization, and an increase in understanding and problem solving, creativity or mental skills, such as learning how to think critically (see Table 1).

Table 1: WAAS-WUC Survey (2017)



2. Openness to the 4th Industrial Revolution

Another important point is that we cannot close our eyes to the consequences (Ramirez and Cayón, 2017) of what Klaus Schwab has termed the Fourth Industrial Revolution (2016), which is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres: ubiquitous, mobile supercomputing, big data, Artificially Intelligent (AI) robots, self-driving cars, neuro-technological brain enhancements, genetic editing… The evidence of a dramatic change is all around us and it is happening at exponential speed. The challenge of Information Technology (IT) is continuously rising throughout the scientific world: everybody is investing more in it and in high-tech, and each time more intelligently. This new IT era is an authentic revolution that will transform our future, increasing the quality of life: higher efficiency, more productivity and less transport costs. What is even more important is that this will transform the talent and creative capacity of human beings.

Some examples of the more conspicuous advances of the present day IT era are mentioned below:

1. **Internet:** we are witnesses of a ubiquitous and an exponential growing web. The internet has become the first global social organization, linking and bringing together different people into a single global cultural community affecting international relations (Choucri, 2013), and forging a common sense of humanity.

2. **Mobile phone** usage and Internet access have exploded. They are important for: social media; fundamental in connecting families across vast distances; needed for Internet banking, education or medical reasons; and for market trading (80% smart phones; smart cities…). In the case of migrants and refugees, their importance goes well beyond staying in touch with people back home: phones become a lifeline, and act as a GPS, which suggests where they should go and whom to trust when they arrive at a certain destination. Of course we also have to be aware that there are also important risks based on rumors leading to misinformation, or sensitive data falling into the wrong hands.
3. **Artificial Intelligence** (AI) may help improve our decision capacity, and unpick the complexity of biology (producing drugs) and advancing human health (prevention, diagnose, and therapy), given that living organisms are complex systems which process information using a combination of hardware and software. In this way, AI will make us more human.
4. **Internet of Things** (IoT) is going to change business more than the industrial revolution did one century ago, encouraging innovation and offering prediction and prevention as one of its most valuable assets; it requires inter-operability among all the different systems and kinds of applications; for instance, a smart city with a digital system enabled an ecosystem which includes citizens, universities, hospitals, companies, governments…

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IT is not free of risks: even if we cannot live without IT, we should also not forget that its use is not free of risks. For instance, social media webs, so efficient for agglutination of attention, are not appropriate for public discourse, given their volatility. They are uncontrollable, unstable, short-lived and amorphous; they appear suddenly and disperse with the same speed, showing a lack of stability, consistency and credibility, as the Korean philosopher Byung-Chul Han (2017) argues: digital communication enables instantaneous, impulsive reaction, and, in fact, it is responsible for the disintegration of communities and public spaces. Suspicions about security have also risen, given the vulnerability of the present digitally connected cyber world (Ramirez and Garcia-Segura, 2017a).

Even more so, our society is moving from alcohol and drug addiction to an **addiction to the virtual reality**. Abusive use of IT creates a dependence on virtual reality**,** in a similar way an addictive drug does: "the same behavior, the same damage: people can become disconnected from society and families and where to maintain a social relationship, a device is needed", as Sean Parke, the founding President of Facebook, asserted at a recent medical event in Axios (Philadelphia). The addiction to new technologies has increased from 0.42% in 2013 to 2.6% in 2016 (Tsitsika et al, 2016).

Parke said he has become a "conscientious objector" to social media because of the harm the social media—not only Facebook, but the wider online ecosystem—is doing to civil society around the world. He even candidly confessed that this social net, created in 2004 by Mark Zuckerberg for Harvard students, purposely hooks and potentially hurts our brains, being conceived from its outset as "addictive", with the purpose of "exploring a vulnerability of human psychology based on the feedback of social validation". He textually said:

- "When Facebook was getting going, I had these people who would come up to me and they would say, 'I'm not on social media.' And I would say, 'OK. You know, you will be.' And then they would say, 'No, no, no. I value my real-life interactions. I value the moment. I value presence. I value intimacy.' And I would say...'We'll get you eventually.'"
- "I don't know if I really understood the consequences of what I was saying, because [of] the unintended consequences of a network when it grows to a billion or 2 billion people and ... it literally changes your relationship with society, with each other ... It probably interferes with productivity in weird ways. God only knows what it's doing to our children's brains."
- "The thought process that went into building these applications, Facebook being the first of them, ... was all about: 'How do we consume as much of your time and conscious attention as possible?'"
- "And that means that we need to sort of give you a little dopamine hit every once in a while, because someone liked or commented on a photo or a post or whatever. And that's going to get you to contribute more content, and that's going to get you ... more likes and comments."
- "It's a social-validation feedback loop... exactly the kind of thing that a hacker like myself would come up with, because you're exploiting a vulnerability in human psychology."
- "The inventors, creators—it's me, it's Mark [Zuckerberg], it's Kevin Systrom on Instagram, it's all of these people—understood this consciously. And we did it anyway." (Parke, 9 Nov 2017).
- Parke's remarks were followed by similar statements of contrition from others who helped build Facebook into a powerful corporation that it is today. For instance, Chamath Palihapitiya, who joined Facebook in 2007 and became its vice president for user growth, told an audience at Stanford Graduate School of Business that he felt "tremendous guilt" about the company he helped make:
- "I think we have created tools that are ripping apart the social fabric of how society works," before recommending that people take a "hard break" from social media.
- "The short-term, dopamine-driven feedback loops we've created are destroying how society works," he said, referring to online interactions driven by "hearts, likes, thumbs-up."

- "No civil discourse, no cooperation; misinformation, mistruth."
- The entire system of venture capital funding pump money into "shitty, useless, idiotic companies, rather than addressing real problems like climate change and disease. And it's not an American problem - this is not about Russians ads. This is a global problem." (Palihapitiya, 2017).

Palihapitiya went on to describe an incident in India where hoax messages about kidnappings shared on WhatsApp led to the lynching of seven innocent people. "That's what we're dealing with," he said. "And imagine taking that to the extreme, where bad actors can now manipulate large swathes of people to do anything you want. It's just a really, really bad state of affairs." He concluded saying he tries to use Facebook as little as possible, and that his children "aren't allowed to use that shit." He later added, though, that he believes the company "overwhelmingly does good in the world."

Antonio Garcia-Martinez, a former product manager at the company, has also said Facebook lies about its ability to influence individuals based on the data it collects on them, and wrote a book, *Chaos Monkeys*, about his work at the firm.

These former employees have all spoken out at a time when worry about Facebook's power is reaching fever pitch. In the past year, concerns about the company's role in the last US election and its capacity to amplify fake news have grown, while other reports have focused on how the social media site has been implicated in atrocities like the "ethnic cleansing" of Myanmar's Rohingya ethnic group.

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This new era of cognitive computing, with an explosive growth of online communication, will transform our future, placing an enormous educational pressure. It will lead to a shift towards a new model of education, with globalized, multi- and trans-disciplinary approaches, increasing intercultural contacts and migration (Ramirez and Garcia-Segura, 2017b). And contrary to the classical research based on results arising out of hypotheses, a big challenge for future education will be its inability to anticipate outcomes. It is subject to unexpected results, given that it is based on less than the 2% of the huge amount of exponentially expanding amount of unstructured data we receive. The supercomputer IBM Watson has calculated that processing such an enormous amount of information would be like analyzing 340 newspapers daily. Consequently, the level of uncertainty in diagnosing our future is becoming higher and higher: we do not know where we are going, but only where we cannot remain. This is what **the education of the future has to resolve: a higher learning capacity and adaptation to the unknown**. According to the 1937 Nobel Prize recipient in Medicine Albert Szent-Gyorgyi, research means "going into the unknown. If you know what you are going to do in science, then you are stupid! This is like telling Michelangelo or Renoir that he must tell you in advance how many reds and how many blues he will buy, and exactly how he will put those colors together" (Szent-Gyorgyi, 1981).

The last important message in this context, concerning machines and robots, is that, far from a false dichotomy where robots will substitute human beings, we have to combine both, with the last decision belonging to humans, because we are the ones who have to know how to use these new inventions adequately. In order to discriminate between the benefits and the eventual risks inherent in the above described world, the famous American inventor and head of research for General Motors, Charles F. Kettering, claims that "**problems are** not solved by apparatus, but **in a man's head**" (Kettering, cited by Boyd, 1957). Our challenge, therefore, is not to use the IT as a substitute for human intelligence, but to "humanize the technology, putting it in the center of all human activities, helping us to potentiate our capabilities. A consequence of these considerations is that our future schools have to include this new knowledge in its curricula, with a special focus on critical thinking, because it will probably be the most demanded and necessary aptitude."

3. Connection with our Inner Self and Nature

The world we have made, as a result of the level of thinking we have done thus far, creates problems we cannot solve at the same level of thinking at which we created them

Einstein (as cited in ICARUS FALLING; 2009)

In general, humans appear to have become disconnected from nature outside and their own inner nature or Self. Furthermore, these two aspects seem to be interconnected. Modern day research shows how environments can increase or reduce our stress, which in turn impacts our bodies. Whatever we see, hear or experience affects us, which not only is related to our mood, but also the workings of our nervous, endocrine and immune system. Our inner thoughts have a certain quantum of energy, and, especially when they are of an emotional nature, also affect our bodies (Lindhard, 2015). Unpleasant environments can cause stress and make one feel anxious, or sad, or helpless which elevates blood pressure, heart rate, and muscle tension and suppresses the immune system. A pleasing environment reverses that. Being in nature, or even viewing scenes of nature, reduces anger, fear, and stress and increases pleasant feelings. Exposure to nature not only makes one feel better emotionally, it contributes to their physical well-being, reducing blood pressure, heart rate, muscle tension, and the production of stress hormones, it soothes, restores and connects (University of Minnesota 1a, n.d.) Nature based therapeutic and recreational services are now also being offered as part of educational programs in universities and research indicates the importance of nature to our health (University of Minnesota 1b, n.d.). This indicates that school buildings and the environment also have to be considered as part of the education system of the future.

Already schools designed by architects who built from eco-friendly recycled materials can now be found in developing countries like Uruguay (UNESCO Green Citizens, n.d.) and South Africa (Sustainability Institute, at Stellenbosch n.a.). In these schools

the tendency is to encourage students to become involved in growing fruits and vegetables. This connects the students with the earth and they can also learn about biology first hand. This trend towards eco-friendly schools is also helping to create sustainable communities, where the inhabitants are more connected with each other and with nature. In these communities, modern technology is used to enhance living conditions, which reduce our carbon imprint, like solar or wind based electricity and cleaning of grey waters. Modern IT is also used to keep people and communities connected without imposing on them the need to live in huge impersonal urban areas.

To help mitigate the problems of today, scientists are now talking of a post-carbon era. This alternative vision "requires overcoming the deep-rooted structural failures of our current business-as-usual model" (Ahmed, 2010, para. 16) which also includes "re-defining the meaning of economic growth to focus less on materially-focused GDP, and more on the capacity to deliver values such as health, education, well-being, longevity, political and cultural freedom" (step 3). Obviously the education system will also need to adapt to these changes at all levels and support this new vision.

The problems we face today seems to stem from an over reliance on our thinking minds which has led to a lack of connection with the soul or inner Self. Education is partially to blame for this as the focus has been only on cultivating our intellectual capacity. A modern day theory of consciousness suggests that Mind-Consciousness is only one of the levels humans can access and that beyond this, there are other levels, some of which are related to the heart and our feeling capacity (Arka, 2013). This theory, known as the Six Main Levels of Consciousness, is based on phenomenological inner experiences, and not on theoretical conjecture. The third level is termed Feeling Mind-Consciousness and it generally "prevails in the heart area and can thus be called the Heart of Heart-Consciousness. It includes an emotional faculty called intuition" (p.37). In general, present day educational systems ignore that there are other levels of consciousness and that children and even the different genders might traditionally have an experiencing consciousness of a different order or level. Recent research involving training in the heart-based Intuitive Meditation method supports the third level of this theory and suggests that we have a level of consciousness associated with the feeling heart which is characterized by certain traits such as intuition, unity, peace, positivity, awareness of emotions, and connection with one's inner Self, called soul, inner being, or atman (Lindhard, 2016; 2017). This is probably related to a level of consciousness, which is linked to the quality of consciousness that is experienced by young children prior to their learning to develop their thinking minds. Research into the heart shows that it has a brain of its own (Armour, 1991; 2007; 2008) and more information is sent from heart to the brain than vice versa (McCraty, 2009).

If the aim of education is to support individuals in the development of their intuitive and creative abilities where they feel connected to their essence or soul, then future educational systems will also need to take these deeper levels of heart-based consciousness into account. They will need to learn how to help students keep the Feeling-Mind consciousness and the developing thinking Mind-Consciousness and their intellectual abilities open. Although the theory of the Six Main Levels mentions deeper levels of consciousness, it seems important that at least the heart-based feeling level is recognized and supported by educational systems. As mentioned, this does not mean that the thinking mind should not be cultivated, but that children should not lose their inner connection to their heart and to their soul. As intuition seems to arise from this level, it also seems vital that people explore this level of consciousness especially if we are to find solutions to the many problems the world is facing today, as suggested by Einstein.

Arka (2003) identifies three planes, living in the mind, living in the heart, and living in the core being. Living in the mind is living a life of sheer materialism where the rules of logic apply and nothing exists except the physical. Living in the heart is "living with depth, with feelings, with emotions, and with creativity. (Here) the heart is using the mind as an instrument to express its guidance—in emotional form, like poetry. The mind is used automatically but consciousness manifests itself mainly at the level of the heart" (p. 60). Living in the core being is "living where consciousness has manifested itself predominately in the deeper self, where your perceptions are beyond ordinary thinking" (p.61). Here the person connects with others easily as their empathy is high and the self uses the heart first and then the mind to express itself.

Although living in the core being is difficult to maintain, it seems that at least we can all reconnect with our hearts again and learn to live from this plane. Not only is it vital so we can begin to access information of a cosmic nature to find solutions for problems, we also all need guidance in our everyday lives in everything we say, think or do. As our inside and outside world appear to be interconnected, learning to live in our hearts again seems to provide a new creative way forward which not only connects us to our deeper Self, but also to nature and the greater whole.

A modern human-orientated educational system therefore needs to take these considerations into account. Education is not about training people for the job market, but developing human beings who are more sensitive, intuitive, creative and connected with their deeper Self and to Nature.

4. Concluding Remarks

We would like to conclude with the words of the eminent WAAS Fellow, Linus Pauling, twice Nobel laureate, in Chemistry and in Peace, whom the senior author of this paper was fortunate to meet with during his post-doctoral stay at Stanford University, in the seventies of the last century:

"How can a system of law be developed to take the place of war in the settling of disputes between nations and to permit (in the words of Jan Tinbergen) a true global economy to be organized to maximize world welfare, undisturbed by national frontiers or national policies detrimental to the rest of the world? **We must provide every person** not only with adequate food and shelter,

but also **with education** to the extent that he can benefit by it, **with the opportunity to develop himself to the fullest extent, to exercise his creativity, to express his personality**." (Pauling, 1970)

In this post-industrial and post-carbon era, the educational system also has to be qualified so that it helps produce more human-centered students and communities that are sensitive to helping preserve nature and the environment and where people are connected with their deeper Self.

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Higher Education and the New Society of Third Millennium*

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1. Education: Expansion and Hostility

Almost half a century ago, the band Pink Floyd had an explosive success with their song "*We Don't Need No Education"*. In 1968, students on riot in American campuses or in the great European universities were shouting, as democratically as possible, "*il est interdit d'interdire"*, militating against the Vietnam War. They were also protesting against famous traditional courses, such as archaeology or classical languages. In March 2006, in Paris, young rebel crowds had set on fire not only cars and police stations, but also schools and destroyed university buildings, starting with the Sorbonne, old symbol of the *Republic of Philology* in Europe and in the entire world. Consequently, democracy generated policies that eventually led to an unprecedented expansion of education as a system, but also to anarchical protests against the expanding system. Why is that so?

Higher education for a democratic society in the 21st century is a topic we can talk about either in prefabricated and politically correct formulas or, on the contrary, we can profoundly reflect upon it in an attempt to comprehend not only what connects the two concepts—democracy and higher education, but also what might disconnect them and even contradict them. What do we, democratic university people, need to do if we wish these two concepts to complement each other? I believe that we should start by elaborating a few theses, which we can then debate further. I would like to propose a few axes for this debate: the first refers to *upstream* education related to the academic stage, the way the past and the social environment put a mark on the university; the second examines the contribution of universities to democracy within the societies which developed them—meaning at *downstream* of university, and the third would refer to universities themselves and their perspectives in a society of knowledge and of a real democracy, that which we all undoubtedly desire.

We can understand that it is natural for any educational process to meet a certain resistance from its beneficiaries. We can understand that the European teenagers and youth aspire to have the advantages of a competitive world, but they refuse uncertainties. We can notice that in a society that made higher education its main social elevator, education is challenged at the very moment when the elevator does not function anymore. We may get sad, or we can try to start the discussion over from its beginnings in the 19th century, a century that empowered education, and most particularly academic education, with the meritocratic system as the position of engine in our travel towards knowledge, instead of favoring hereditary elites of the old aristocratic regime.

It may be possible that hostility against school, as it sometimes appears nowadays, arises also from the fact that the educational system is disconnected from the realities of contemporary society. I do not refer here to the often called-upon adjustments to the labor market requirements. Numerous experiences and experiments have proven that the maximum adaptation to these exigencies is not shown by the young beneficiaries of an early specialized education, either we talk about IT or other modern specializations, but, on the contrary, by those who have passed through a training, intelligently centered on the traditional fundaments of science and culture and who gain thus a flexibility that allows them to further choose the highest fields for their professional career.

2. Reinventing School

In order to avoid these expensive confusions, we must reinvent the school so that it will know how to preserve and use its passionate interest for exploration, for bringing out the inherent novelty and curiosity for knowledge in the student. It must be a school that transforms every child's passion for stories into an ability to use proper words. It must be a school that puts in service of the didactic process all the colorful fantasies of childhood, and the explosive inventiveness of teenage. Briefly, it should be a school that awakens the joy of learning. Such a school integrates and does not compete with the almost infinite information means that today's society generates continuously. We will have to reinvent school so that it will not exclude, but include. It should take into account every child's and teenager's talents, so as to offer him or her a customized path that will tap his or her personality to the fullest. Under present circumstances, of the Informatics and Information revolution, the biggest effort necessary to reinvent the school radically is not one involving economic effort, but one concerning intellectual endeavour.

Universities, which are at the same time beneficiaries of the educational process and its latest corollary, have the duty to reflect upon this vital issue and to fight for a real democracy that is based on knowledge and for a new humanism capable of radically rebuilding our contemporary society.

Will this process be adopted by our democracies? Will the families, the local communities, the mayors, the local administration, the governments, parliaments, be willing to take the chance to support and finance such a radical reform, to open the way to an adaptive, flexible education, that is able to mould itself on any child's, adolescent's, adult's or third age active people's needs and potentials?

The University, conceived as a great forum, will last as a part of the democratic world as long as it continues to promote critical thinking, reason, pluralism, human values. The confrontation of ideas in a critical, rational manner requires not only an acceptance

* Talk presented by the author at the panel on critical issues for the future of higher education, WAAS, Roma Tre University, November 16, 2017. An extended version of this article was published in the October 2014 issue of Eruditio Journal

of differences, but also paying rightful attention to others' views. Because concepts and experience might become obsolete if there is no interest, interrogations and freshness in the youth's thinking, to give debates color and to generate novelty, meaning the *creative technologies* needed in a knowledge society.

3. The Prospective Mission

We live in a world that wants to prove the triumph of democracy, freedom and cooperation, an open world, a world of constant communication and interaction, a world whose perpetual motion cannot be stopped and where isolation would mean a form of collective suicide. Yet, this world is not yet ready for globalization. If we want to understand why, it would be the right moment for us to turn to the University's prospective mission. It is the moment when the university should find within itself the necessary resources to give a new impulse to the world we live in.

Academic institutions' identity and role in the assessment of 21st century challenges no longer need to be demonstrated. The specialists we educate today will be active until 2050-2060, so their projective capacity represents an indispensable component in this process. In this sense, adopting a development strategy requires a few prior clarifications regarding anticipation: the general framework of the society's evolution, the forecasting of supply-demand ratio of the academic capitalization valorization, the assessment of human potential and material resources.

My generation left many questions unanswered. I have no regrets for, if a new generation asks the same questions, the answers will undoubtedly be different from the ones we would have delivered, as the world the older generations used to live in has changed. We sought answers to what we hoped to be a world of certainties. The only thing we know for sure today is that this world will be a world of uncertainties and that answers to the exact same questions will change more rapidly than we can imagine. Professors, researchers and university graduates are, today, the measure of future. Thus, universities may be considered an essential partner in the endeavor of shaping the future.

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Future Education: A New Paradigm

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"Education for all throughout life": This was the main conclusion of the First World Conference on Education organized by UNESCO in Jomtien, March 1990. For all and very importantly, throughout life. This became the new title of the main programme of UNESCO on Education that was called "Literacy and basic education".

With the advent of digital technology, the World Congress was held at a moment in which, for the first time in history, the voice of "We, the peoples" was raised and listened to by the governments.

It must not be forgotten that, until the end of three decades, a vast majority of human beings were born, lived and died in different square kilometres... They were silent, obedient, fearful...

Now, they can express themselves freely, they are aware of what happens worldwide and, very importantly indeed, women are progressively taking part in the decision-making processes. As Nelson Mandela told me in Pretoria, in 1996, when I was claiming that the culture of peace did not have the full support that I expected, I proclaimed that "Until now, we have had only male absolute power. Now, before long, women will become the cornerstone of the new era, because women only exceptionally utilize the force whereas men exceptionally do not."

Every human being is unique and must be able to fully exercise their distinctive faculties: to think, to imagine, to anticipate, to innovate, to create! This is the real hope: we can redress the present trends and design a new world for the times to come.

We are all diverse biologically and intellectually at every moment of life, in the course of a permanent evolutionary process, but united by the universal values of justice, freedom, equality and solidarity, which are so well enshrined in the UNESCO's Constitution.

Therefore, education must be progressively person-centred and values-based. All human beings are equal in dignity: this is the supreme distinctiveness of humanity, as emphasized in the Charter of Fundamental Rights of the European Union (2000), and education must make people "free and responsible", who are the "drivers of their lives", as defined by Professor Francisco Giner de los Ríos in 1876.

Freedom represents the most exclusive human capacity and therefore any kind of determinism, fanaticism, dogmatism, supremacism... must be completely disregarded because in all these attitudes ignorance prevails over reason.

Philosophy, the art of "thinking what nobody has thought" and the artistic disciplines, which promote artistic creativity, are the essential learning disciplines.

In 1992, I requested the President of the European Commission, Jacques Delors, to chair a World Commission in order to define the main avenues of education in the XXI Century. In its report the Commission established:

- Learn to be
- Learn to know
- Learn to do
- Learn to live together

I added "learn to undertake", because to the famous dictum of "*sapere aude*", "dare to know", it is necessary to add "know how to dare", because otherwise knowledge is useless. "Dare to share"! (knowledge, experience, views, etc.) in order to take advantage, particularly now that life longevity has increased, of the immense treasure, normally unknown and unexplored, of every human life.

It is therefore very clear that the following confusions must be avoided:

- Education and professional training
- Knowledge and information
- Information and news

Reports on economic growth promoting institutions like OECD insist on the learning of abilities, technologies and professional capabilities when what really counts is *to be* fully human!

Furthermore, the immense media power results very frequently in the mix-up of information and news, as so precisely commented by Bernard Lawn, the Nobel Peace Prize laureate of 1985, it is indispensable to think in the context of the whole when the media focuses only on the part. "We must see the invisibles to realize the real extent and depth of the news... Only if we are able to see the invisible we will be able to do the impossible," he added.

Only truly educated peoples will know when humanity faces processes of no return if *timely measures* are not adopted and how to make possible the historical transition from a culture of imposition, domination, violence and war to a culture of encounter, dialogue, conciliation, alliance and peace. *From force to word*, from "*Si vis pacem, para bellum*" to "Si vis pacem, para verbum"!

There are some reference documents that I consider worthy of mentioning here:

- The UN Charter (1945)
- The Constitution of UNESCO (1945)
- The Universal Declaration of Human Rights (1948)
- The World Plan of Action on Education for Human Rights and Democracy (Montreal, 1993)
- The Declaration on a Culture of Peace and Religions (Barcelona, 1994; Lille, 2009).
- The Declaration on Tolerance (UNESCO General Conference, 1995)
- The Declaration of the General Assembly of United Nations on "The Culture of Peace and Non-violence of the Children of the World" (1998). (Decade 2001-2010).
- The Declaration and Programme of Action for a Culture of Peace (General Assembly of United Nations, 1999).
- The Charter of Fundamental Rights of the European Union (2000).
- The Earth Charter (2000).

With this guidance, the five priorities of the UN could be implemented:

- food
- water
- health
- environment
- education.

Regretfully, neoliberalistic policies prompted by the Republican Party of the United States have always been against democratic multilateralism, and at the end of the "Cold War" in the 80s of the last century, the party substituted the United Nations by the plutocratic groups (G6, G7, G8...G20) for worldwide governance and, even worse, ethical values by the market ones.

The global situation today, with global threats potentially irreversible, requires the timely adoption of measures to address the present challenges.

The transition from an economy of speculation, production delocalisation and war (more than 4 billion dollars per day invested in armament and military expenditures while thousands of persons, most of them children from 1 to 5 years old, die of hunger and extreme poverty) to a knowledge-based economy for a global human and sustainable development is particularly important. But this radical and indispensable change will not come from today's modalities of governance, which are market-dependent.

Now is the time of "We, the peoples". Peoples who know and are ready to raise their voices. Educated peoples able *to participate...* free and responsible, the driving force for the transformation so urgently required.

We need to become citizens of the world, because the threats we face are global in nature. Citizens need to be fully conscious of their crucial role to act in such a way that the main responsibilities towards humankind are fully accomplished; to promote evolution and to avoid revolution; to behave in order to implement a new concept of security, not only in territories and frontiers but to create an atmosphere of a dignified life for those peoples living in less secure territories, through an important "disarmament for development"; to take advantage of a "new concept of work" and to redefine labour conditions; to rebuild the United Nations System from scratch, which is absolutely indispensable to ensure the rapid and full realization of the Sustainable Development Goals (SDG) and Climate Change measures.... which will eventually lead to a culture of peace and non-violence worldwide.

The scientific, academic, artistic, intellectual communities at large, must be at the forefront of world mobilization in this respect. Education has to pave the way for a new era. Education has to reinvent the future: this is a truly relevant intergenerational duty.

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The Challenges for Future Education: A Global Perspective

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1. Introduction

Today we are living in a globalized world where interconnections between human beings as individuals, and nations and states, are becoming wider day by day, making us encounter cultures that are pretty different from our own.

These interactions are increasingly growing not only because of the modern amazing tools that make them easier than in the past (take the internet and the social networks for example), but also because today, as a globalized world, we find ourselves in front of difficult and complex challenges which necessarily need a global response in order to be solved: we need each other to survive not only as nations and states, but as a species. So, what is the role that higher education systems should play in this context? Universities across the world host students that one day will be the leaders of our world, those who will work to solve national problems and who will cooperate with other leaders in order to solve global issues and to build a more united international community.

This is why universities should provide their students with all the right tools that they will need in future not only to have a successful career, but also to be able to create valid international cooperation that will allow them to find creative and shared solutions for all kinds of problems.

But now the question is: what are these tools?

2. Moving Towards a Global Education

Universities are places where the adults and leaders of tomorrow are forged. It is then very much important to make higher education free of charge for those students coming from lower income social classes: this is a first step to ensure that those who are willing to invest their time in higher education are able to do it so they can direct their lives towards self-realization; in this way not only will we stimulate social mobility, but we will also build a fairer society with a qualitatively better human capital. Resuming free education means better chances for both individuals and societies.

Having said that, we need to remind ourselves how universities should be places where students not only are taught, but where they can grow as self-conscious and self-confident individuals, finding the chance to acquire important skills while developing their personal qualities, understanding what their path is in life. At the same time, they should be educated in order to be able to live in this complex world, knowing its history and its characteristics in an in-depth way.

Education should then be based on three main pillars:

1. Knowledge
2. Competency
3. Values and skills.

2.1. Knowledge

a. knowledge of the globalization process: students should be able to fully understand globalization, analyzing it in a critical way; they should know how to recognize its positive effects but also be aware of the negative ones, thereby learning how to deal with them.

b. knowledge of human history and philosophy: students should interiorize through education those that can be considered the most important and universal human values, such as the prominence of human rights, of democracy and of social justice; they should learn the fundamental significance of dialogue both between individuals and countries/cultures.

2.2. Competency

a. critical thinking: universities should teach students to deal with complex problems and to analyze them with a critical and open mind; students should also learn the importance of reconsidering their opinion in the face of new evidence.

b. ability of seeing problems and facts from different points of view: this is a very important point. How can universities ensure that students are able to fully understand a particular issue? The answer may be multidisciplinarity or even transdisciplinarity: these two approaches can be central in showing students how different disciplines can contribute to explain the complexity of the world and its challenges.

Today's problems and challenges are much more complex than in the past and cannot be explained in any satisfying manner if not analyzed from every possible point of view: only in this way we will be able to see the whole picture and to take wise decisions in order to tackle problems. Different disciplines should collaborate in a student's education in order to make him analyze and resolve complex issues.

c. intercultural competency in communication: this is an aspect that must not be underestimated. A university student should be taught to recognize the worth of any culture and to understand how every single socio-economic system can contribute to enrich

the whole world. Our own culture is not the best in absolute terms. At the same time, not only recognizing the worth of other cultures is important; it is fundamental to give students all the right instruments to create solid communication canals with other cultures, in order to establish a strong cooperation which is indispensable for tackling global problems, which require global solutions that can be reached only through an active cooperation built through mutual respect and understanding.

It is very important that students learn how to imagine a common future with better living conditions for everybody. Future education should find then a new paradigm that challenges inequality by boosting feelings of solidarity among human beings, allowing students and future leaders to see themselves as part of a bigger human community.

d. team working: this is all about making sure that students participate in activities which require teamwork: only with constant practice in such kinds of activities they will understand how everyone can contribute in the achievement of a particular goal, on the basis of our personal qualities and skills.

e. ability to deal with conflicts: conflicts, when we talk about humans, considered both as individuals and as societies, are pretty common, probably even inevitable. This is why students should be taught how to avoid them or, when necessary, how to deal with them in a wise way: talking about international politics, they should understand how war prevention is one of the most important issues in the world today. Our chances of survival as a species are based on the capacity of preventing wars and other kind of conflicts.

2.3. Values and Skills

a. self-esteem, self-confidence: Even if these two elements seem to be quite simple to understand, they must not be taken for granted: in universities students should understand that the worse kind of failure is not trying: they must be encouraged to commit themselves to studying and to all kinds of parallel activities. They should be encouraged to get out of their comfort zones and to try new activities and challenges: if they fail, they must understand that from failure we rise. Failure helps us to improve our skills and to correct our mistakes. If they succeed in their tasks or activities, their confidence gets a boost: if we are able to develop fully confident youth, not only we will raise the chances of seeing them achieve their goals in life, but we will have raised great individuals whose life will have a positive impact on the whole society.

b. social responsibility: students should learn the importance of social justice, the importance of creating a fairer world at all levels—national, regional and global levels.

c. environmental responsibility: we have only one planet, but we still take it for granted. Students must learn that it is our responsibility as humans to make sure that our environment is respected. Especially today, since one of the main global issues is global warming, a complex problem which connects different dimensions of our living: politics, economics, etc.

3. Methodologies

What can be some good methods to make sure that higher education can provide students with the needed skills and abilities?

Here are a few proposals:

3.1. Global connections between universities.

It is important for students, as already mentioned, to know other cultures and comprehend their values. How can this be done?

a. student exchange programs: implementing and strengthening student exchange programs is probably the best possible way to achieve this goal. Sending students to study abroad and welcoming students from different parts of the world is the absolute best way to ensure an interchange between countries and to let students understand other cultures and countries and their points of view.

b. hosting researchers and professors coming from other parts of the world: by doing this, universities will enrich their didactics, giving students the chance to benefit from listening to professionals with different approaches to teaching.

c. making sure that students know about the existence of the so-called MOOCs: in this way students will know how to have online access to courses taught by other universities. Universities should participate in this, and have their courses on online platforms.

3.2. Making students work on a project

Students should learn how to work on a project both alone and in a team. Such projects should also be presented and discussed in front of the whole class, so that students learn not only to write an essay, but also to speak properly in front of an audience.

3.2. Making sure students have access to cultural anthropology courses.

On the basis of my very personal experience, I think the importance of anthropology is underestimated: this subject can provide students with the right tools and knowledge to understand cultural relativism: there is no hierarchy between cultures and knowing this is fundamental in order to create a valid cooperation with other countries.

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SECTION 4

WHERE TO BEGIN: CHANGE NEEDED AT THE PRIMARY LEVEL

Start Early, End Strong

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The international norm of fostering education for those aged six through university is completely out of date. The start is too late and the finish is too early. It is time to combine three things: what neuroscience tells us about the development of the brain; our knowledge about the changed economy and our prospects for a much longer productive life; and our strategies for education. Combining these factors lead to a more holistic view of education as a life-long endeavor. We also have important opportunities to improve the quality of societies by educating future adults to be less violent and more innovative citizens.

1. The Five Phases of Education

We first present an overview of what new understandings from science imply for the five phases of a desirable educated life.

1.1. Phase 1: Birth to Primary School

The single most important factor that determines whether or not any child will be educable and will be capable of success in school is the brain development experiences for the child that happen in the first three months and first three years of each child's life.

Education can have a transformational impact on the life of a child, and society should place a very high priority on giving each and every child the right set of education opportunities—but we all need to realize and understand that children who have the wrong set of experiences in those first three months and first three years will not have the brain power and the intellectual capacity to take advantage of the education opportunities that might exist for each child.

The basic biology is the same for every child. Neuron connectivity in the brain is necessary for each brain to function, and the time frame when that connectivity can be created and strengthened happens in the first months and first years for each child. That process changes significantly for each child after those first key years.*

The basic biological truth is that the brains of infants begin an actual pruning process by age four—and that pruning process functionally eliminates the best neuron connection opportunities for each child because it actually purges unused connections from the brain.

Developmental programs for children that are aimed at increasing the basic intelligence levels of a child that begin after age four begin too late to have significant impact on children.

After age four, we can and should help each child with issues of judgement, wisdom, emotional security, and interaction functions and skills, but we cannot significantly improve the basic core learning capabilities and intellectual strength that result from the neuron connectivity levels in each child's brain.

We have major learning gaps in many of our American schools today between groups of children. That has been a major area of concern for many of our communities. Average learning levels differ significantly between groups in many of our schools. There have been a large number of very well intentioned programs that have been aimed at closing those learning gaps over the past couple of decades since the gaps were first detected and measured.

We now know why those programs to close those gaps have failed in so many settings. The functional and foundationally biological truth is that we cannot close those gaps at fifteen years. We can only close them at fifteen months. We need to help each child from each group in those high opportunity time frames because we owe it to every child to give each of them the best trajectory into their education experience.

We cannot close the gaps once they exist for a group of children, but we can keep those gaps from coming into existence. We can prevent those gaps from happening.

We now know that children whose brains are exercised in the first months and years of life by having caring adults talking, reading, and directly interacting in clearly responsive ways with each child, have much stronger—and even physically larger—brains by age three.†

Children who do not have adults interacting directly with them, talking directly to them, and reading books and other written materials to them have many fewer neuron connections in their brains and have both smaller and less functional brains than the children who do have those interactions.

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* "Baby' Brain Begins Now: Conception to Age 3," Urban Child Institute, undated.

† Bjorn Carey, "Language gap between rich and poor children begins in infancy, Stanford psychologists find," Stanford Report, September 25, 2013. See also Joan L. Luby et.al, "Pre-school in a sensitive period for the influences of maternal support on the trajectory of hippocampal development," Proceedings of the National Academy of Sciences, 113:20, May 17, 2016. Also see Allisan Eck posting, "Stress from Poverty Decreases Brain Size – Even at Birth," (a review article) Nova Next, March 15, 2015. And see ThreeKeyYears.org. Recent research findings are summarized by Better Brains for Babies at http://www.bbbgeorgiz.org/recentresearch.php

It is important to have those interactions with each child before the age of four, because the basic biological truth for every child is that each brain changes and goes through a pruning process at age four that eliminates a very high number of neuron connections that have not been used prior to that time. Connections that have been used become part of the permanent capability of the brain, and unused connections permanently disappear.

The impact of those interactions begins immediately—even before birth. Children are born able to discern in the first hours of life that a new language they hear is not the language they heard before being born.

Several very important epigenetic processes are engaged immediately for each child. We all have our genetic composition and we have the ability of our genes to modify the function based on the experiences that we face. Epigenetic changes are important before birth, and some very important epigenetic determinations happen for each child immediately after birth.*

In the first weeks and months of life, children who are hungry and are fed and who are stressed and then comforted—have their brains wired in response to those positive experiences.

But children who are hungry and not fed and who are stressed and not comforted in those first weeks and months end up with a different set of behaviors and attitudes toward the world around them.

Children who have negative experiences in those first weeks and months can end up with an attitude of Presumptive Negativity—where they assume all interactions have a high likelihood of being negative.

Rhesus monkeys go through very similar processes based on their experiences immediately after birth and the young monkeys have similar negative interaction patterns and tendencies.

Researchers at Columbia University have been able to film and measure less than ten minutes of mother/child interactions at one hundred days old and those researchers have been able to predict with an extraordinarily high level of accuracy which children will have learning problems and emotional attachment challenges at three and five years old.†

A number of studies have now shown that the children who have fallen behind in those key areas by the time they reach kindergarten, tend to never catch up with the other children in their schools.‡ Those children who have fallen behind by that point are far more likely to drop out of school—in part because school can be hard and unpleasant for students who cannot read.

A very high percentage of the students who drop out of high school end up with serious health problems. The health status of drop outs tends to be significantly worse than the health status of graduates.§

The drop outs are also much more likely to go to jail. That is true for children from every group.

For African American males without a high school diploma, "There is nearly a 70% chance that they will be imprisoned by their mid-thirties." That compares to under ten percent of the high school graduates. (See evidence from the Hamilton Project of The Brookings Institution.) Ten percent of a horrible number and sixty percent is far worse. We can predict with an extremely high level of accuracy at age three which African American males (or members of most major groupings in the U.S.) will be going to jail because we now know at age three which path each child is on.

Education levels are extremely important predictors of both health status and incarceration. Drop outs have higher teen pregnancy levels, higher rates of drug use, higher rates of asthma, and even higher rates of diabetes and heart disease. (Vaugh, et.al. op.cit,)

The trajectory to better or worse health, and the trajectory to employment or incarcerations is heavily influenced by the first months and years of life for each child—and we need to take those factors into consideration in determining education policy and strategies in all countries.

We need a world-wide program to teach that information to every family, parent, and community, because the new science is not known in most settings and the people who want their children to have better lives deserve to know what they can do in basic ways to make their children's lives better.

Those issues are particularly important right now because we live in a world with many regions facing active inter group conflict and war. More than 65 million people are in exile right now from their home countries and millions more continue to live in war zones. We need to pay particular attention to the impact of war zone experiences on the first weeks, months, and years of life for each child.¶

We need our care teams, our communities, and our families in war zones to all understand how important it is to give our children in those settings the sense of stability and safety they need to do well when those epigenetic processes are activated for each child. We should also predict as economists that future work force and health care realities will be damaged due to those factors.

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* Ibid. especially National Academy of Sciences paper.

† Beebe, Cohen and Lachmann, The Mother-Infant Interaction Picture Book, WWNorton, 2017; also see review of this and other research on "Mother-Child Relationships to Infant Brain Size on the April 29,2017 blog of the Institute for InterGroup Understanding http://www.intergroupInstitute.org/blog/author/admin/

‡ Julia Isaacs, "Starting School at a Disadvantage: The School Readiness of Poor Children," The Brookings Institution, March, 2012.

§ This finding is one made in a number of studies, e.g., Vaugan, Salas-Wright and Maynard, "Dropping out of School and Chronic Disease in the United States," 2 Gesundh Wiss, 2014, Jun822(3), 265-270 found in http://www.ncbi.nlm.nig.gov/pmc/articles/PMC4164164/#!po=32.7586

¶ "Growing Up in a War Zone Permanently Damages Kids' Brains," UNICEF news release, March 24, 2016; "One in Nine Children Being Raised in War Zones," UNICEF news release, May 7, 2016. See also "Safe Spaces: Protecting Brain Development in Emergencies," www.TheirWorld.org

All of these factors call for educating new parents to start early in the education of their child, and it calls for school systems to institutionalize very early "pre-school" education systems. Italy is an interesting positive example, now starting schooling at age 3, which is much better than systems that start at age 6… although by our reckoning still late.

1.2. Phase 2: Primary through High School

When the world's education ministers met in 1990 and again in 2000 they focused strongly on universal basic (i.e., primary) education. At the 2000 meeting for which co-author Berg was senior advisor, his attempt to interest the education ministers in early childhood education was not successful. In the years since the emphasis has shifted from quantitative expansion of primary education to increases in the quality of primary education.

But let us assume for the moment that children get good birth-to-primary school preparation to learn. What happens then? We now know that if early childhood education gains are not well followed up in primary education, those gains will be lost. Indeed, experts on early childhood education, call the first years of primary school the new frontier of challenge for excellence.*

Knowing what we now know from education linked to sound brain development (in part from the Mother's Service Society's early childhood schooling programs in Pondicherry, India), a realistic goal for students with a recommended early start in learning would be for students by age 7 to be able to learn how to learn. This means competency in using hard and soft data to research issues in their education and, of course, facility in the use of computers. This point relates directly to the economics of education. While adding early childhood and early formal education programs to national systems will increase the education budget, teaching children to research well will reduce the costs of education later on. And, as noted above, better educated early education will result in less expenditures on criminal control, and health programs and much higher earnings. Indeed, several studies on the economics of early education show a sizeable net economic benefit to society.

There are many implications for secondary education, but we will focus here only on one. Prior to secondary school graduation, students should be exposed to the basic lessons of responsible parenthood including how to teach their future very young children to learn.

We make two observations about formal grade school systems. First, there is a lot of experimentation and innovation going on in education around the world. Much of this is valuable. But, second, formal school authorities are very slow to adopt the best innovations in learning…and this is often compounded by inadequate training and sporadic or missing upgrading of teachers. Effective public administration incentives for changing systems and using good innovations are badly needed.

1.3. Phase 3: Tertiary and Vocational Education

The World Academy and this conference focus a good deal on higher education, with particularly interesting findings on the merits of a mixture of distance and 'bricks and mortar' based education.

There has been much less focus on vocational education and the economic incentives to make hiring labor more competitive than paying for new capital equipment. Famously, Germany presents an outstanding example of strong national and local policies to foster vocational education tied to the needs of its job market. This is certainly a model for wealthier countries. But we do lack viable models of vocational education for less wealthy economies and this is a true challenge, particularly in economies that have low growth.

Some believe that the answer is to foster micro-enterprises, but budding small business entrepreneurs require training, too. We note that while some leaders of the development evaluation field…e.g. Esther Duflo and Dean Karlen…have raised doubts about the efficacy of micro-finance programs, there is general support for technical assistance programs for micro-enterprises.

1.4. Phase 4: On the Job Training

Unfortunately, for a variety of reasons…particularly the unrooted mobility of capital as well as the rise of artificial intelligence and robotics…stable employment in middle income and higher income countries is seen as increasingly difficult. Indeed: "The risk of holding a poorly paid, precarious or insecure job is higher today than it was in 1995."† And this risk is much higher for youth in all categories of countries, including the wealthy.

The question is 'how is labor valued,' and this turns out to have an important cultural dimension. A survey of top managers in several OECD countries asked what they felt was the peak age for the productivity of their workers. Managers in the US and Europe the productivity of their workers peaked in their young 50s. In Japan it was age 44. In Taiwan it was age 38. An implication is that managers are more prone to stop upgrading their workers' skills if they feel their workers are past their prime.

The issue of preserving and enhancing workforces is so important it has become a security issue. The US National Intelligence Council's 2017 "Global Trends" report says the following:

"Initiatives to provide continuous workforce education, enable a mobile and secure workforce, and preserve technology leadership in multiple disciplines will enhance the resilience of states to potentially disruptive advances in technology, such as automation, data analytics, artificial intelligence, and biotechnologies. Such resilience would mitigate the near-term risk to jobs and markets, and allow the technologies to produce greater economic efficiency and productivity over time."

* See "The Current State of Scientific Knowledge on Pre-Kindergarten Effects," Brookings Institution Report and Conference 4/17/17

† United Nations, "Report on the World Social Situation 2016, p. 2

The report goes on to recommend more public-private continuing education, and the development of curricula by universities in consultation with employers to upgrade workforces. All this is seen as necessary for economic progress and social stability.

Fortunately, there are positive examples of training when technology changes occur. "Energy companies have begun to figure out how to retrain workers over the course of their careers as jobs in power plant control rooms and on production platforms shift towards the overseeing of automated systems."*

The Academy could very usefully compile and discuss how to foster an evolving responsibility of societies to help people keep jobs, let alone obtain them. It would be particularly useful to know which countries at various income levels are doing well in retaining employees.

We believe that good early childhood education can echo in improved workforces. For example, early experiences in socialization and team work, in finding creative solutions, in taking pleasure in eye/hand coordination tasks, can lead to workers who better problem solve and who help raises the productivity of the organizations within which they work.

1.5. Phase 5: Education for the Retirement Years

Many years ago one of us met with a group of men in Bangladesh who complained that their pension plan (then a rarity) came on line at age 55, five years after the average age of death (!) Today the average lifespan for men in Bangladesh is over 70 years of age, somewhat above the world average. (World Health Organization, 2016). So now in many countries of the world ranging in income from Bangladesh through OECD countries, people who have worked and been able to save or who have pensions are able to contemplate many years, often 15-25 years, of capable life after they retire. Currently, those years are most often of little use to society. So the question is whether much more socially useful post-retirement years can be achieved. Most retirees, i.e., those who served in special purpose governmental or corporate institutions, are ill-prepared to give back to society in their retirement years. So a new field of education is just beginning to emerge.

At the elite level is Harvard's Advanced Leadership Initiative, started in 2009 and the only program in the 381year history of the university that bridges all its graduate level professional schools. Topflight retired leaders of organizations (most from high paying corporate positions) are assumed to know how to run organizations. They are now taught how to help change large social issues. For most of these very capable students, this is brand new learning. The quid pro quo for being in this one-year program is that graduates must start an initiative that is intended to favorably address an important socio-economic problem.

The Harvard program could usher in a new generation of university students: people in their late 50s or early 60s, just at a time when the university-age populations in many countries is declining. To many universities this will be a wonderful opportunity to add revenues and fill out their campuses with students.

In many countries short term courses rather than expensive programs like Harvard's, could be devised to help people be more productive volunteers, to learn the art of political advocacy, and to teach how to mentor. In Mozambique one of us urged the country to take advantage of retired civil servants ("for lunch money") to volunteer as teachers at a time when there was an acute shortage of teachers.

2. Two Key Cross-cuts

Good educators have clear societal goals for their educational programs. These are important to consider and update from time-to-time. There are two dimensions of future education we believe should be added to national educational goals: educating for less violent societies, and education for creativity, particularly for innovation for the public good.

2.1. Fostering Less Violent Societies

> *"What begins with the failure to uphold the dignity of one life all too often ends with a calamity for entire nations."*
>
> – Kofi Annan, Nobel Lecture, December 10, 2001.

The general evidence is that most children, in numerous countries studied by UNICEF covering all regions, experience violence against them. UNICEF has compiled the evidence on the proportion of children aged 1-17 who experienced any physical punishment and/or psychological aggression by caregivers in the month prior to the surveys. In the vast majority of countries (i.e., 53 of 64) studied, the prevalence rate of such violence was over 60%, "with a prevalence rate of over 90% in 12 countries" including Ghana, Tunisia, Egypt, Palestine and the Central African Republic. The lowest prevalence rate was Cuba's with a still shocking rate of 36%. (UNICEF data from their MICS and DHS data surveys reported in *SDG 16 Progress Report*, Institute for Economics and Peace, Sydney, September 2017.) Children who are at the receiving end of aggression in the large number of societies where this is "normal" are already being socialized to understand that aggression is normal.

Learning to live a more peaceful life is a major challenge for humanity. The first step in creating a less violent world, like the first steps to so many of the issues discussed in this paper, is to train expectant parents to be far wiser in their parenting. Known factors for young children in fashioning more humane citizens include acceptance by their parents.†

* Vice and Yanosek, "The Next Energy Revolution," Foreign Affairs, July/August 2017, p. 131

† Valeeva and Kalimullin "Effects of Parent-Child Relationship on the Primary School Children's Non-Violence Position Formation," International Journal of Environmental and Science Education, Vo. 11. No. 13, 2016.

Another fundamental factor is early exposure to people from different backgrounds. As a distinguished study by top experts on diversity, states: "Expanding the comfort zone beyond same-race companions and friends (or other similarities such as culture, ethnicity, religion, nationality) to include cross-race interactions is an important challenge and the obstacles begin at 3 months of age."*

Early childhood educators often have solid ideas on how to educate for less violence. The early childhood teaching goals recommended by one widely used text† sets these four anti-bias goals:

1. Each child will demonstrate self-awareness, confidence, family pride, and positive identifies;
2. Each child will express comfort and joy with human diversity; accurate language for human differences; and deep, caring human connections;
3. Each child will increasingly recognize unfairness, have language to describe unfairness, and understand that unfairness hurts; and
4. Each child will demonstrate empowerment and the skills to act, with others or alone, against prejudice and/or discriminatory actions.

As in other areas of education, there must be follow up throughout education if we are to curate a society that is less violent and more caring. There are also key tasks for societies (particularly those centers of mass media—Hollywood, Bollywood, Nollywood and Rollywood) to reform mass media to reduce the popularization of violence in movies and videos. Numerous reform initiatives have received support by media leaders, but very little has changed, and arguably violence is increasing in mass media.

It is time to bring the world's educators into the initiatives to reduce violence in societies.

2.2. Education for Creativity for the Public Good

Our contemporary society does a fine job in fostering creativity for private gain. There are excellent MBA programs found in good universities all over the world. We would argue this is an imbalance for society's needs. There is increasing recognition of the need for creativity to help solve numerous problems to enhance the public good, just at the private sector strives to be creative to serve the private good.

Two strategies can promote creativity for the public good.

The first is augmenting existing curricula to expand horizons towards enhancing the public good. Swarthmore College in the U.S., for example, is actively soliciting ideas to strengthen curriculum and programs to enhance social impact. The renowned brother of WAAS Fellow Lloyd Etheredge, Lynn Etheredge, has proposed six new courses for Swarthmore: A review of great revolutions and social movements; the science and practice of contemporary democratic social change; designing and accelerating a world of human flourishing; digital technologies to transform our future; studies in effective social change; and systems thinking and its many uses. (Discussion Draft, May 29, 2017).

While we applaud the approach of augmenting regular education by special courses that will stimulate people towards being social change activists, we also believe that more fundamentally we need to create the equivalence of MBAs for social change experts. Perhaps this would be an MSE, a Masters in Social Enhancement. The elements of such a program should be introduced early and honed in the MSE program. Arguably, the world's leading experts on social change (especially social entrepreneurship) are found at Ashoka, by far the most significant global networks of successful social entrepreneurs, some 5000 in number. Ashoka assessed the ventures of their Fellows that have operated for five or more years and concluded that 80% have had their solution implemented by others; 59% have directly influenced national policy; and that each Ashoka fellow is helping an average of 174,000 people.

Ashoka believes that everyone should be a social innovator and that, based upon the lives of their Fellows, there are four values that need to be inculcated in our young: empathy, teamwork (open teams to see and seize ever-changing opportunities), new leadership (in which every person on a team looks at the big picture and advances solutions contributing to positive social outcomes), and change-making (the capacity to freely and effectively innovate for the good of all).

Beyond reforming education, governments and global institutions…as well as academies like WAAS…have an opportunity to foster better solutions while inculcating a more democratic spirit of problem solving, if they approach solving problems differently. Currently, the primary way that solutions are found is through small, navel-gazing meetings and individual efforts. The more interesting way to find solutions to specific problems is through open systems such as Open Source Competitions. Occasionally the UN and major firms like IBM have run open source competitions in which a very large global community is asked to contribute ideas (on open platforms) to specific problems. Not only is much more creativity developed, but a much wider constituency for solving the problem is created. And stronger legitimacy if given both to the sponsoring organization and to the ideas they promote…if the process is demonstrated to be inclusive, tapping into (e.g.) all the scientific academies and networks of social entrepreneurs.

Training a new generation to work in open systems to help promote public well-being, and demonstrating by example the use of such systems will, we believe, add to the quality and political support of better ways of solving challenges.

* Jones, Dovidio and Vietze, Psychology of Diversity, Wiley Blackwell, 2014.

† Anti-Bias Education for Young Children and Ourselves, Derman-Sparks and Edwards, 2010

3. Conclusion

In sum, what we are advocating is a much more holistic approach to education, appropriate for each stage of life, from birth onward. We believe that the substantive and policy case still needs to be made in most societies for many parts of this holistic approach and we further believe that the Academy could help stimulate countries to think more systematically and holistically about education of their peoples.

One reason that vital pieces of education are missing to create continuously growing and meaningful lives, is that there is little evidence of effective conceptualization of lifelong learning, and only limited and fragmented responsibilities for policies and programs that create a continuum of continuously improving education services appropriate for each stage of life.

There is a serious challenge to education authorities to have an oversight of this whole process, striving to improve it, to embrace all peoples, to meet a wide variety of needs, and to keep solidarity with the needs, potential and opportunities for added worth for the lives of their citizens.

At the global level, it is increasingly important to highlight successes in educational reforms along the above lines as countries learn best from peer learning. But we also have to recognize that most countries are still striving to meeting lower level educational goals, let alone embracing mid and later life educational needs. And there are even fewer examples of nations working conscientiously to foster less violent and more socially productive societies. There are thus many opportunities to pioneer educational reforms along the above lines.

Some years ago the World Academy held a fascinating conference to discuss the Future of Human Potential. We believe there is a serious gap between what is education now and what human potential could become…a gap that if narrowed would make a great deal of positive difference for the future of humanity.

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Breaking Barriers with Building Blocks: Attitudes towards Learning Technologies and Curriculum Design in the ABC Curriculum Design Workshop

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Abstract

This paper investigates the efficacy of the ABC Curriculum Design workshop that was developed by the UCL Digital Education Team. The workshop was created in response to a wider critique in the HE community on quality of curriculum design and was meant to help realise the university's strategic initiatives on promoting blended learning. Acknowledging lecturers' limited time, the Digital Education Team designed a quick 90-minute teamwork activity to help educators design engaging learning activities. Running for almost two years, the workshop is widely acclaimed and has been organised in different universities around the world. However, no study into the impact of the workshop has been conducted yet. This study aimed to start answering this question on the impact of the workshop. It particularly looked at the participants' attitudes towards curriculum design and learning technologies before and immediately after the workshop. These are two of the main points the workshop and the underlying institutional strategies are trying to target and attitudes are often a precursor for future behaviour. Two qualitative case studies were carried out, involving interviews and focus groups with a total of 8 workshop participants. The interview and focus group transcripts were analysed through a thematic analysis in N-Vivo. The research found that the participants were overall very positive about the workshop, particularly about the (learner) framework, collaboration opportunities, reflection opportunities, interactive format of the workshop and the possibility to include student input in the design process. The workshop likely changed participants' attitudes around curriculum design.

1. Introduction

The ABC Curriculum Design Workshop was developed in 2014 by UCL's digital advisory team, whose role it is to promote blended learning and digital technology across the university (Young and Perović 2016). It is an engaging 90-minute card-based approach to curriculum design (Young and Perović 2016; Young and Perović, n.d.). The main aim of the workshop is for participants to design engaging learning activities for their programmes. Usually, participants work together in teams, based on the programmes they are looking to design. Together, they have to create a 'storyboard' that shows the type and sequence of learning activities and the type of assessments they want to employ in order to reach their module's learning outcomes.

At this stage, the interactive and hands-on workshop has been trialled with great success over a variety of programmes and even across a variety of universities and countries (Perovic 2016). While it was developed with specific UCL strategic initiatives in mind, namely UCL Arena, Blended Learning and Connected Curriculum, the workshop has proven to be very adaptive to other settings.

While the workshop has had positive responses from participants, no research has been conducted into the impact of the workshop yet. In order to address this gap and to help create more understanding of and find ways to improve the workshop, this research project, broadly speaking, looks at the effectiveness of the workshop. Specifically, this research focuses on the participants' attitudes towards curriculum design and learning technologies before and directly after the workshop, to see if there are any changes. It also looks at the participants' experiences in general to advise on how the workshop could be improved.

This research addresses these points by taking a qualitative case study approach. Participants from two workshop groups were interviewed before and after their workshop session, with the post-workshop interview being a focus group. Additionally, all participants filled in a survey about their backgrounds in education and with technology.

This paper presents a brief review of the literature, focusing on the pedagogy behind the workshop and how it aims to help participants with curriculum design and inspire them to use more learning technologies. Subsequently, the research design and methodology are described and the findings and preliminary conclusions presented and addressed across the two case studies.

2. Workshop format

As visualised in Figure 1, the workshop is organised in the following way (Young and Perović 2016; Young and Perović 2015-2016): The workshop organisers start by introducing the different elements and background of the workshop, running through the theory and tasks of the workshop. Then the participants start their first task, which is creating a 'tweet' that summarises the outcome or main selling points of the module in order to get all team members on the same page. They then have to draw the shape of their programme by indicating in a spider diagram the amount of learning types they expect their course to have. For the main part of the workshop, the participants then work on sequencing the learning types on the module's timeline or storyboard, represented on an A1 paper (see Figure 2). After they have agreed on the result, they turn over the cards and choose activities corresponding to the learning type on the card from a list of online and conventional activities (see Figure 2). Participants can also add their own activities.

Next, the participants decide on where they want to apply formative and summative assessment methods. These are indicated by gold and silver stars. Finally, the participants go back to the initial spider diagram they made and draw another one, after having

thought about the learning types in their design during the workshop. If the session has multiple modules across a department or programme, the participants can also walk around and look at each other's storyboards, learning about and discussing each other's plans in relation to their own. At the end of the workshop, participants will go home with a visual 'storyboard' containing the type and sequence of learning activities required to meet their course's learning outcomes and will have had an opportunity to discuss their plans with colleagues and workshop organisers. This framework will help them in the rest of their module planning.

Figure 1: Flow Chart of Workshop Activities

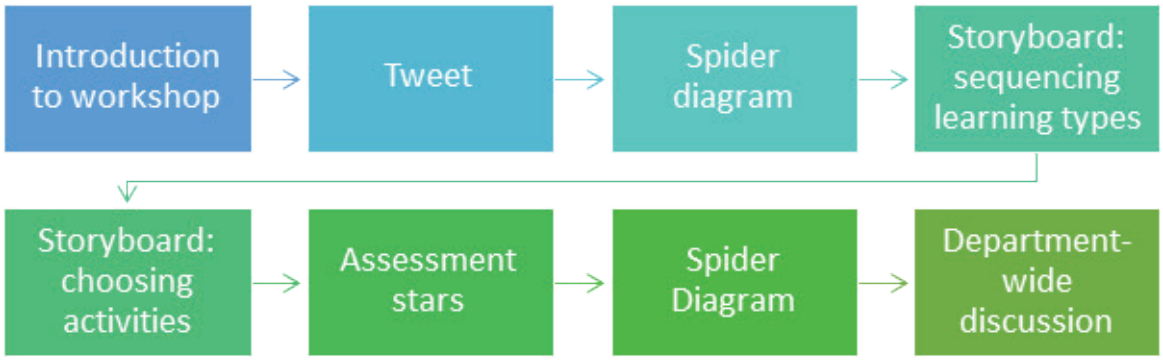
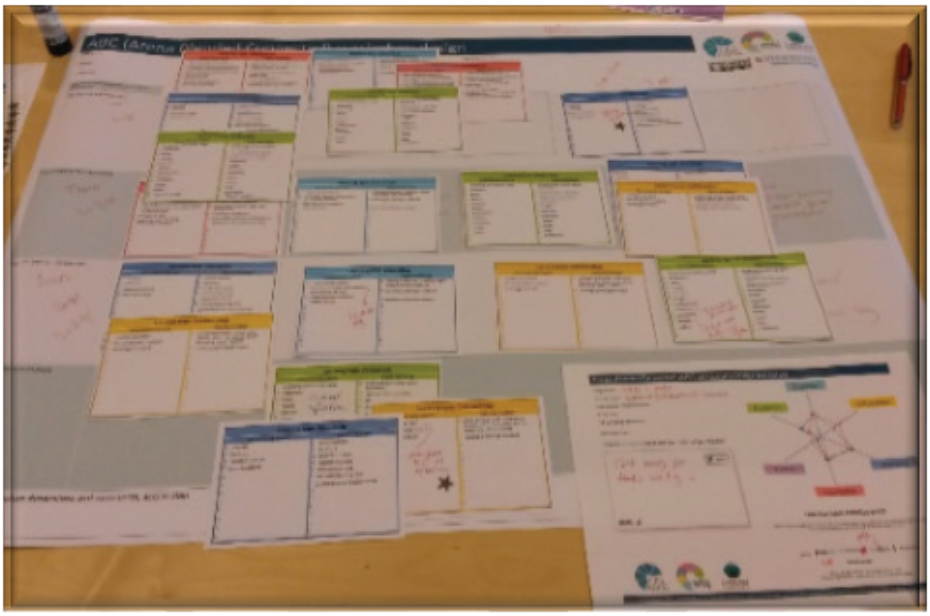


Figure 2: Example of Finished Storyboard with Cards



3. Literature Review

3.1. Attitudes towards Curriculum Design (CD)

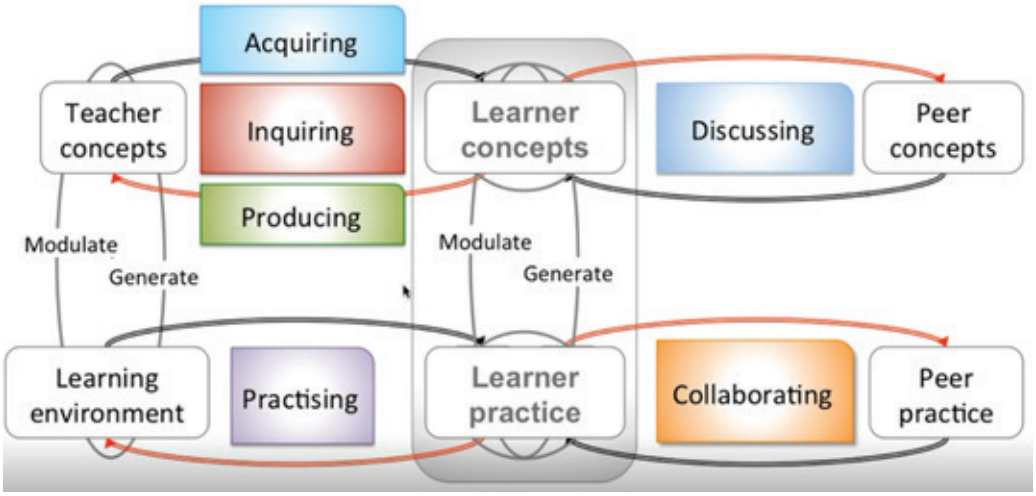
Coming from the need to provide help to teachers to design or redesign their blended or online programmes, the ABC workshop was a response to a wider critique on the quality of curriculum design in HE (Nicol 2012; Beetham 2012; Young and Perović 2016). The workshop organisers realised that something needed to be done to improve the design process, but were also wary of existing methods that take up a lot of time as they realised that lecturers do not have a lot of time to spend on their curriculum design (Young and Perović 2016). As they explain, "for a process to be adopted at UCL it would have to show time efficiency for curriculum teams and other stakeholders" (Young and Perović 2016, p. 391). Their research focused on gathering the best of existing approaches and structuring it into an appropriate format. The workshop's developers ended up using two development projects in particular, JISC and the University of Ulser's Viewpoints project (JISC 2012; University of Ulster 2012) as well as Diana Laurillard's research on learning types at UCL's IOE (Laurillard 2012; Laurillard 2013-2016).

From the first project, they drew on the idea of using a storyboarding approach, which included a large course 'canvas' and a set of cards to be selected, sequenced and annotated. As the project was positively reviewed in terms of helping to identify curriculum design challenges, its focus on education rather than content and its focus on the learner rather than the teacher (Nicol 2012), the ABC team decided to use a similar approach (Young and Perović 2016). This focus on 'education' and the 'learner' comes from the field of Learning Design, which is a model of education that "is based on the concept of a standardized "language" or framework to describe educational activities" (Dalziel 2008). According to Dalziel, it particularly focuses on group work over individual work over a structured series of activities (2008). Learning Design is defined by Koper as "the description of the teaching-learning process

that takes places in a unit of learning (e.g. a course, a lesson or any other designed learning event)" and its key principle is that "it represents the learning activities and the support activities that are performed by different persons (learners, teachers) in the context of a unit of learning" (Koper 2006, p. 13).

The organisers based the content of the cards on the six learning types identified by Diana Laurillard as part of her Conversational Framework, which is developed to represent and analyse formal learning environments and meant to challenge the use of new technologies in learning (Laurillard 2012). The framework's aim is to "represent, as simply as possible, the different kinds of roles played by teachers and learners in terms of the requirements derived from conceptual learning, experiential learning, social constructivism, constructionism, and collaborative learning, and the corresponding principles for designing teaching and learning activities in the constructional design literature" (Laurillard 2012, p. 93).

Figure 3: Laurillard's Conversational Framework, including the 6 learning types (Image taken from lecture video (Laurillard 2016))



As illustrated in Figure 3, Laurillard identified six different learning types that correspond to the different communication cycles of her framework. The ABC card set is based on these learning types, consisting out of six cards, one for each learning type: acquisition, inquiry, practice, production, discussion and collaboration (Figure 4). Acquisition involves learning through reading or listening. Inquiry or investigation involves students exploring and questioning resources. Practice involves students using their skills for a task and improving them based on the feedback. Production involves students using their knowledge in practice by creating something. Discussion involves students responding to and challenging each other. Lastly, collaboration involves a combination of discussion, practice and production, working together to practice new skills and creating collaborative work by challenging each other and reaching agreement.

Following this theoretical background, one can theorise that the ABC curriculum design workshop is experienced by participants as helpful in elucidating and providing a structure for the design process (through the storyboarding approach) and focusing on pedagogy and the learner (through the focus on learning types) rather than the content or the teacher. These are therefore two points that are addressed in this research.

Figure 4: The front of the ABC cards, explaining the 6 learning types

3.2 Attitudes towards Learning Technologies

As the workshop is meant for blended courses, one of its aims is to promote the use of learning technologies among the participants, which it does implicitly in several ways. At no point during the workshop, however, do the organisers prescribe any kind of technology or do they suggest how to use learning technologies. They do give them the option to choose between conventional and digital activities on the back of the cards. The organisers hope that giving participants these options will stimulate them to reflect on their choices and consider what activities would work best in their overall curriculum and for their students. The use of learning technologies is thus encouraged implicitly through the design but not through the delivery.

Moreover, as the ABC Curriculum Design Workshop has a learner-centred theoretical background at its core, it is important to note the observed positive link between learner-centred attitudes of teachers and their use of technology in the classroom (Becker 2000; Niederhauser and Stoddart 2001; Norum, et al. 1999; Bai and Ertmer 2008). Several studies showed that teachers who held learner-centred beliefs were more likely to use technology frequently and to engage with technology-supported student-centred learning activities. Teachers with more traditional teacher-centred beliefs, however, were less likely to use technology and, when they did, it was mostly used to reinforce skills. Thus, using a learner-centred framework in its design is another contributing factor to how the ABC Curriculum Design Workshop could stimulate participants to use more learning technologies.

Consequently, the workshop's approach ideally would give participants more positive attitudes towards the use of learning technologies, overcoming existing ideological barriers to actually use the technologies in their teaching (Bai and Ertmer 2008; Ertmer 1999; Ritchie and Wiburg 1994). As Bai and Ertmer explain, "attitudes towards technology are expected to predict one's uses of technology" (Bai and Ertmer 2008, p. 108), because "attitudes and beliefs are a subset or a group of constructs that name, define, and describe the structure and content of mental states that are thought to drive a person's actions" (Richardson 2003, p. 102). When teachers are positive towards learning technologies, they are more likely to use them and vice versa. Thus, looking at the participants' attitudes towards learning technologies in this study is worthwhile as it could be considered an indication of their future technology use and, by extension, the successfulness of one of the workshop's aims.

When it comes to the implementation of technology into education, Ertmer argues that there are two types of barriers to technology integration, 'first-order barriers' and 'second-order barriers' (Ertmer 1999). The first are barriers extrinsic to the teacher and include, for example, lack of access to hardware and software, lack of time and lack of administrative or leadership support. The second are intrinsic to the teacher and include, for example, their beliefs and practices. Ertmer explained that as second-order barriers are personal and generally ingrained in individuals, this barrier is harder to overcome. Thus, "achieving technology integration is a multifaceted challenge that entails more than simply acquiring and distributing computers" (Ertmer 1999, p. 53).

Following Ertmer's classification of barriers, the ABC Curriculum Design Workshop addresses both types. It addresses first-order barriers by providing support and promoting institutional strategies in the form of expertise and tools for teachers to design their curriculum. Moreover, the workshop addresses the more complex second-order barrier by providing a space for reflection and collaboration. In her article, Ertmer explains 3 ways to overcome second-order barriers. These are modelling good practice, reflection on their own practice and collaboration with peers. These processes are mainly supported by professional development activities, which have been identified in many studies as a way to help shape teachers' beliefs (Cifuentes 1997; Daniel 1996; Hart 2002; Gibbons and Norman 1987), and are also supported in the ABC Curriculum Design Workshop.

4. Research Design

4.1 Research Questions

Addressing the implicit goals of the workshop around blended learning and learner-centred theoretical approaches, which are driven by institutional strategies, it is important to analyse how the workshop potentially changes or shapes (institutional) attitudes. The overall research question of this project is:

> *How did the participants' attitudes towards learning technologies and curriculum design change during the ABC Curriculum Design Workshop?*

To break down this question to more workable parts, several sub questions were created:

Figure 5: Research Questions Overview

Research Questions

Attitudes towards Learning Technologies

- RQ1: What are the participants' attitudes towards pedagogical uses of technology before the ABC Curriculum Design Workshop?
- RQ2: What are the participants' attitudes towards pedagogical uses of technology shortly after the ABC Curriculum Design Workshop? And what are the links between these attitudes and the different parts of the workshops?

Attitudes towards Curriculum Design

- RQ3: What are the participants' attitudes towards curriculum design before the ABC Curriculum Design Workshop?

- RQ4: What are the participants' attitudes towards curriculum design shortly after the ABC Curriculum Design Workshop? And what are the links between these attitudes and the different parts of the workshops?

Experience of the Workshop

- RQ5: How did the participants experience the workshop? How can their experience be improved?

4.2. Methodology

While 'attitudes' can be measured both quantitatively as well as qualitatively, qualitative research is deemed most suitable for this project as qualitative research allows for in-depth analysis of a phenomenon. The methodology used is a case study approach. This research project used interviews and focus groups to obtain data, after which both case descriptions and case-based themes were created to provide the reader with rich, thick descriptions of the cases and the overarching themes. Participants also filled in a short survey to gather some background data. The interviews were used to address the first and third research question, focusing on attitudes towards learning technologies and curriculum design before the workshop. Focus groups were used for the other questions, focusing on the attitudes towards learning technologies and curriculum design after the workshop, their links to the workshop and overall experience of the workshop. Both interviews and focus groups were run through semi-structured interview guides. This project followed BERA's ethical guidelines (BERA 2011) and was reviewed and approved by the UCL IOE Research Ethics Committee.

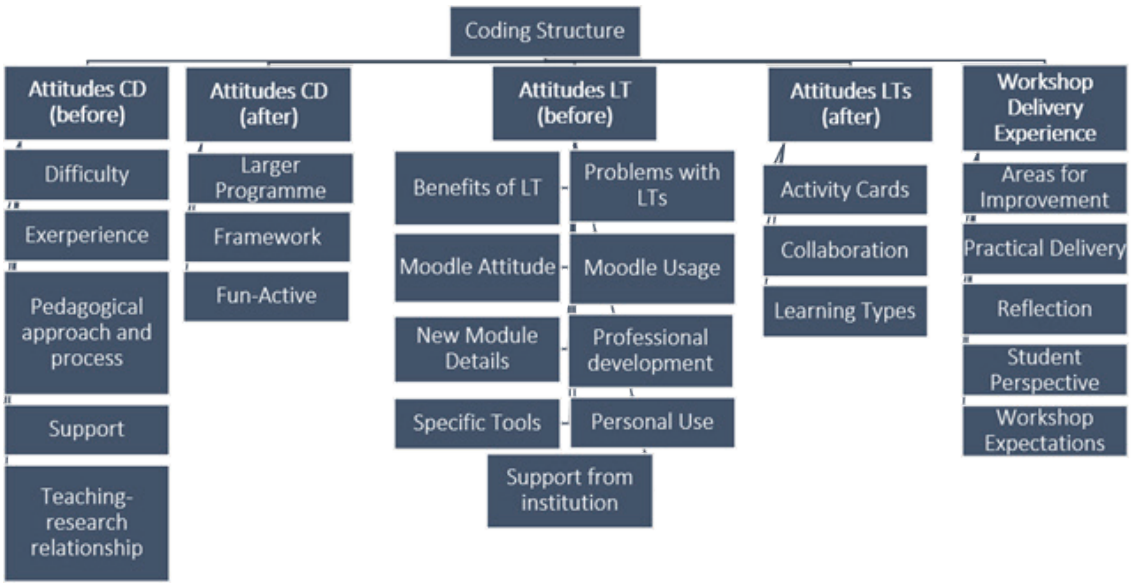
4.3. Participants

The participants were higher education lecturers in London, United Kingdom. The focus groups and interview participants were selected based on availability during the selected time period. Due to the restricted timeline of the study, the data collection period was limited from March to May 2017. In part, there was homogenous group sampling as workshop groups were chosen that were already pre-existing teams (Patton 1990). Within these groups, participants were purposefully sampled based on their availability and interest. The first case study revolved around a workshop that had 15 participants. Five of these participants took part in the research. Two did a pre-workshop interview and all five participated in a post-workshop focus group. Two focus groups were run. The second case study revolved around a workshop that had 4 participants, of which three participated in the research. All three participants did a pre-workshop interview and a post-workshop focus group. All interviews and focus groups were held face-to-face, except for the pre-workshop interview with participant 3. This interview was held via Skype due to limited availability for scheduling a face-to-face session.

4.4. Data Analysis

After the interviews and focus groups were transcribed, they were imported into N-Vivo 11 for coding of the data (QSR 2017; Bazeley and Jackson 2013). In order to stay close to the research questions, the first coding system followed was one of Structural Coding as it allowed the researcher to create an initial structure of the data based on the research questions by coding it into categories (Saldana 2011). In N-Vivo these categories are referred to as family nodes. After creating these categories, the "similarly coded segments [were] then collected together for more detailed coding and analysis" (Saldana 2011, p. 67). The nodes were thus broken down into different codes, aiming to find themes within those research question-specific categories, doing a Thematic Analysis (Saldana 2011, p. 139). The next-level codes were generally based on topic or evaluation. The resulting coding hierarchy can be found in Figure 6.

Figure 6: Coding Hierarchy



5. Results

5.1. Summary of Case Study A

Participants were generally quite experienced and positive about learning technologies (LTs) as many had experience with online and blended courses already. While participants had experienced some glitches with Moodle, UCL's VLE, they were generally positive about the tool. However, even the most digitally literate participants still struggled with some LTs at points and we need to be aware of this complex spectrum of attitudes towards LTs. After the workshop, participants lauded the learner-centred approach and the collaboration and reflection opportunities within the workshop, which should help participants to overcome any second-order barriers to integrating LTs relating to attitudes and beliefs:

> *"I think it was helpful for me to make a distinction between collaboration, discussion and investigation, kind of the terminology, and within that that you have examples what could be done, what activities within those domains or learning types, so that's very helpful too" (P5, post-workshop fg)*

> *"Working in a group to do curriculum design is really helpful. I had no idea how to, you can't bring everyone together and just have a discussion without having anything to pin it down with" (P4, post-workshop fg)*

> *"Having the workshop forced me to engage at all with it, 'cause I hadn't had the time to and yeah I can't tell whether it is having some time to reflect on this, you know having the time and having the space to do it, or whether it is the scaffolding that the workshop particularly provides." (P6, post-workshop fg)*

The activity cards were considered to be potentially useful, but most of the participants had not been able to sufficiently review them due to time constraints.

With a limited experience of curriculum design before the workshop, they appreciated the framework, collaboration opportunities and connection to the wider context that the workshop offered. However, the latter was not sufficiently done during the workshop. Some illustrative quotes include:

> *"Having a framework to get more concrete steps and ideas rather than just a kind of emerge yourself in it and do what you think without kind of guidance or framework" (P6, post-workshop fg)*

> *"It is more fun in a way. When you start to think of you have to plan the curriculum of module […] it can seem a little daunting because it seems like a big task to do, so having this is an entry way into starting to plan curriculum which is nice, cause it is kind of a fun, you are moving, you are sticking things around, so in terms of breaking down that initial barrier it is good" (P8, post-workshop fg)*

> *"It gives you something to help bring the different modules together. It is quite clear that everyone had the opportunity to learn a little bit about the some of the other modules, even if it was just the Tweet at the start and then everybody has those as a common framework." (P4, post-workshop fg)*

Participants expected to be presented with a framework, to work collaboratively and to have some energy injected in the normally quite tedious curriculum design work. These expectations seem to have been met quite well. This workshop group also included a student as a participant, which participants also found very valuable and would recommend this for any future workshops:

> *"I think when our table got one student, so we got his feedback, which is very helpful, to see not just us the module tutors, structure deciding module, but get his feedback and their expectations and what is good and what they like so that's very helpful" (P5, post-workshop fg)*

Some points for improvement of the workshop included better communication with the participants before the workshop, recommend the workshop after participants have had sufficiently time to think about the content of the module (which links to better communication with participants beforehand) and better/more explanation of theory at the beginning of the session.

5.2. Summary of Case Study B

Participants were very experienced with LTs, with Participant 1 slightly less experienced than Participant 2 and 3 in the amount of different LTs that they use. All of them had experience with blended courses and felt supported by their institution and department to develop their knowledge of LTs. While they clearly did not like to use Moodle and some other prescribed technologies like TurnItIn, they were generally positive about using other LTs as long as they had a clearly-identified purpose. Again, this complex spectrum of attitudes towards learning technologies need to be pointed out.

After the workshop, participants were very critical about the activity cards and the spider diagram exercise, feeling they were not useful for them. Perhaps this was because participants were already digitally advanced and thus were more critical about these LT aspects of the workshop:

> *"I think it could open the way to more prescriptive activities when you are listing things. People could feel like they have to tick something, but they might be wrong." (P2) "I kept feeling like I was doing it wrong because I was never checking the boxes and it was profoundly irritating. Like here is another one where I am doing nothing that is an approved method" (P3, post-workshop fg)*

"I suppose at best this is just a thinking tool [pointing at the A4 Tweet and spider diagram sheet] like the big sheets you can take this away and put it into practise but it should have been made clear what this is" (P2, post-workshop fg)

The learner-centred framework, however, was found useful, even though participants did not discuss them at great length. The opportunity to collaborate and reflect on their module was also considered valuable:

"I think it was helpful to have some time face-to-face to talk with my collaborator who is very busy" (P3, post-workshop fg)

However, as participants were already frequently using LTs, this most likely has not addressed any second-order barriers.

With a limited experience of applying a pedagogical framework to their curriculum design (and one participant with no curriculum design experience at all), they valued the introduction of a framework and the ability to collaborate in contrast to working on it by themselves. They also appreciated the ability to discuss their modules in a wider context. Some illustrative quotes include:

"I guess before this I would have touched on some of these and included as a matter of course in a way how my pedagogy goes, but it was good to actually put them in blocks and actually put some strategy behind it rather than what came intuitively" (P2, post-workshop fg)

"I think the most effective thing we did was that walking on the paper with the coloured cards only because we did that exercise at the end which was related back to the programme itself […] because the actual content of the module is going to move depending on the cohort you have right, but the relationship back to the larger programme itself is never going to change" (P1, post-workshop fg)

Participants expected to learn about how to design their courses better, which was achieved through the introduction of the learner-centred framework. They appreciated the hands-on format of the workshop and the opportunities to reflect and collaborate.

Participants suggested some improvements regarding the workshop elements, which included leaving out binary distinctions of activity cards, creating a digital version of the workshop and including a worksheet to address the wider programme of the module. They also felt that the workshop should be held before the validation process, so that participants could actually apply what they had learned during the workshop as it was not allowed to change the courses after they were validated:

"It would have been more useful before I had my module validated than after, because we obviously have to hit the same things for module validation that we do, that we went over in the actual workshop itself, so I think the timing was a bit off" (P1, post-workshop fg)

They also felt that communication with the participants on the workshop's aims could have been better.

6. Discussion and Conclusions

Most participants in the case studies had quite some experience with technology already, having done online or blended courses before, and so the concept and workings of a blended course were not new to the participants. Both case studies had a participant(s) that was quite an advanced technology user (Participant 2, 3 and 4), having had positive experiences with a wide variety of technologies. All participants had had experience with Moodle, as it is UCL's VLE. While group A was generally positive about it, group B really did not like the software, showing that attitudes towards LTs should be viewed in a nuanced differentiated way as part of a complex spectrum. None of the participants had had a teaching degree, only some pedagogical and/or LT workshops or diplomas. Also, none of the participants had a lot of experience with curriculum design, a few having designed 1 or 2 curriculums before.

After the workshop, both groups expressed their appreciation of the learner-centred approach and the accompanying framework. As participants had very little curriculum design experience, this was considered a useful tool in helping them design their curriculum. Participants also found the opportunities for collaboration and reflection valuable. This was especially the case for participants in Group A and should help them with their development, particularly when it comes to their attitudes towards CD and LTs. Concluding, attitudes towards curriculum design most likely changed from before to after the workshop as participants had limited experience with CD and were not familiar with any pedagogical CD framework, and there were overwhelmingly positive responses to having a learner framework, time for reflection and opportunity for collaboration. It seems that UCL's strategic initiatives that have been built into the workshop from the start have influenced the participants' attitudes.

Neither group was very enthusiastic about the activity cards and spider diagram exercise. Group B felt that the activity cards were too binary and prescriptive, while Group A just had not really gotten the chance to look at time as they had run out of time. For Group A, the spider diagram was confusing as they had not fully understood the learning types, while for Group B they just did not understand the purpose of the exercise. Looking at the participants' diverse experiences with LTs and the mixed responses after the workshop, the workshop most likely did not change their attitudes towards the use of LTs. Reflection and collaboration, however, are important for changing educator's attitudes towards LTs when they are reluctant or hesitant to use LTs, which none of the participants were.

Both groups valued the opportunity to discuss their modules in a wider context, however both would have liked to have seen this aided for more. Group A heavily recommended the input of the student voice in the workshop and they also both liked the hands-on, interactive format of the workshop.

A summary of these findings can be found in the Table 1. A summary of the areas for improvement suggested by the two groups can be found in Table 2.

Table 1: Summary of the Study's Findings

RQs	Before	After	Change?
Attitudes towards CD	Limited experience, those that did have experiences saw it as an easy individual process, not based on any pedagogical framework	Participants were overwhelmingly positive about having a learner framework to pin their designs on. Collaboration with peers and time for reflection were also considered positive parts of the workshop	Likely
Attitudes to LTs	All participants had some experience with online or blended courses. A few were very experienced technology users. Participants had had positive as well as negative experiences with LTs.	While participants enjoyed the collaboration and reflection which are important for changing attitudes towards LTs, as they were already quite experienced this would probably not have had an effect. Participants were critical about the activity cards and spider diagram.	Unlikely
Workshop experience	n/a	Pros: student voice present, interactivity, collaboration (for design and for context), reflection Neg: see table on areas for improvement	

Table 2: Summary of the Suggested Areas for Improvement

Area for Improvement	Recommended by	What does it entail?
Stage of the workshop	Group A and B	While Case Study A emphasised that participants should not do the workshop too early on in their design process, Case Study B participants explained that once the course is validated it is not as useful. A balance needs to be struck.
Communication	Group A and B	Both groups felt that communication with the participants could have been better. They would have liked more information beforehand on what the workshop would cover and what they should (or should not) prepare or bring along.
Better explanation of theory	Group A	Participants felt that the learning type's theory was rushed and could be explained better at the start so they feel more confident going into the exercises. Group B did not mention this, but they did have more knowledge of the learning types before the workshop than Group A seemed to have.
Digital version	Group B	Participants thought the workshop 'screamed for' something digital, particularly when looking at the tweet and spider diagram exercise, also thinking about taking notes, erasing things, rearranging things.
Link to wider programme	Group B (and A)	Participants mentioned they would have liked to see more of a link to the wider programme by for example including a large sheet encircling the storyboard that shows where it fits into the wider programme. Group A also briefly mentioned that they wished they had had more time looking at each other's work as well as they ran out of time.
Rearrange activity cards	Group B	Participants felt that the binary distinction between conventional and digital activities was not helpful and suggested activities were too prescriptive/limiting.

7. Implications for Further Research

There are several limitations to this study, particularly because it was a small-scale pilot study. This was mainly due to restrictions of time and resources. Future research should look into a larger group of participants, perhaps draw on quantitative data from a large sample in order to have some generalisable results.

Doing research with more participants, either more qualitative case studies or quantitative large data sets, will also most likely give more diversity in the sample. In this research, all participants were women based at a UK university from just two different departments. A more diverse sample could address this limitation in the future.

Another limitation could include that the two workshops were delivered by different people. While there was not much specific feedback about the workshop organisers, the way they delivered it, perhaps deviating from the standard delivery, could have affected the participants' experience.

Additionally, this research only looked at participants' reactions right after the workshop. It could be argued that participants' responses right after the workshop might not be indicative of what they ended up taking away from it in the long term. It would be worthwhile to invest time and resources into a longitudinal study that actually addresses if the participants have implemented what they have learned into their final designs and how their opinions and attitudes might have developed by then.

Lastly, but perhaps most interestingly, as this workshop is built on UCL's strategic initiatives, it is worth looking into the impact the workshop has in other institutions and countries and if and how their own institutional strategies are brought into the workshop. Are the ABC Curriculum Design Workshop's building blocks able to break barriers across the board?

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Young Children, Digital Technology and the School of Tomorrow

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Abstract

Our society is being digitised, which means that digital technology transforms every aspect of the society. Smartphones and tablets have literally invaded our daily life and children are becoming digital users from an early age. They easily adapt to these everyday objects. Alternative pedagogical approaches share common values enhanced by digital culture, such as development of the senses, investment and mutual aid, as well as autonomy. The relationship between alternative approaches and digital technology creates a new type of education called "Education by digital technology". The underlying idea of this type of Education is to consider digital technologies as pedagogical tools instead of risks for young children. Thus, digital technology serves the child's development, in the context of a pedagogy stimulating the interaction between the young child, the teacher and the digital tool. Numerium, the author's diploma project, is a device that allows "Education by digital technology". It is a digital tools tank in which children are informed and educated about digital technology. By raising awareness of digital technology use among young children, we support them to become responsible, intelligent users of digital technology.

Our society is being *digitised,* which means that digital technology transforms every aspect of the society. Smartphones[1], tablets and computers have invaded our daily life, and thus children become digital users from an early age. They easily adapt to these everyday objects.

Even though the environment around children is being digitised, it is not the case in schools and even less in kindergartens. Teachers, by lack of means or by reluctance, do not use digital technologies very often in their classrooms. Usually, people do not want to put young kids in front of screens even though most of them have already used a smartphone or tablet on their own (for some children, this happens everyday).[2]

Early childhood is the fastest and the most complex stage of our development as human beings. What we realise at this age will have an influence over our future life. Through raising awareness of digital technology use among young children, we influence children's perception of these tools. We support them to become responsible, intelligent users of digital technology.

We tend to consider digital technology only as screen interfaces. And these are often perceived in a negative way. However, used wisely, these interfaces can be beneficial to the child's development. Moreover, digital tools are not only screen interfaces, but also tools with numerous sensors that can generate new functionalities.

The underlying idea of this paper is to consider digital tools as pedagogical materials instead of risks for young children. Thus, digital technology serves the child's development, in the context of active teaching stimulating the interaction between the young child, the teacher and the digital tool.

1. Digital Technology and Alternative Education

In order to understand the issues related to the relationship between young children and education, I became increasingly interested in early childhood education's role, as well as the emergence of alternative pedagogical approaches.

Early childhood Education is the period when the young child develops many skills such as speech and language development, gross motor skills, social and emotional behaviour, or even learning of reading, writing and counting. The first three years of primary education have an influence on cognitive, social and behavioural development.[3] These are the years of emancipation, when the child builds his own personality.

A young child's development depends on the pedagogical approach used from a very young age, e.g. his education between two and five years old. Over the last few years, the success of alternative pedagogical approaches has increased around the world. We could considerate this phenomenon as a school renewal with new pedagogical methods fostering children's well-being. Montessori, Reggio Emilia, Decroly, Steiner Waldorf and Freinet are the main educators who have revolutionised the 20th century School. These different pedagogical approaches share common values, such as development of the senses, investment and mutual aid, as well as autonomy and knowledge and understanding of the environment.

By taking interest in Montessori Education and Reggio Emilia Education, I have noticed common features. For example, in Montessori, the concept of *"The Absorbent Mind"*[4] is really strong. The child "absorbs" and replicates the movements and actions that he has observed in his own environment: speech is a good example of absorption such as touch screen gestures in our present world.

In Reggio Emilia's approach, the term *"The Hundred languages"*[5] refers to the endless ways and opportunities in which children have to express themselves such as painting, writing, dancing, playing music, and so on. We can perceive digital tools as means of expression—for example, the smartphone can be used as a camera.

These examples prove that alternative approaches can be improved by digital technology instead of being against. Their values can be enhanced by digital culture.

2. Towards a New Education by Digital Technology

The relationship between alternative approaches and digital technology creates a new type of education that I call *Education by digital technology*. This Education uses digital interfaces to facilitate new interactions. Not only does this pedagogical approach motivate students but it also leads to perceiving the digital tools differently—with all its sensors, smartphone can become a musical instrument for example.

Digital tools have not been created with a pedagogical intention, however they hold pedagogical virtues such as autonomy, children's curiosity solicitation and educational support. Indeed, digital interfaces encourage a multi-sensorial experience by relying on touch, sight and hearing at the same time. Moreover, the emotional dimension focused on digital tool engages a child's motivation, which helps to develop investment and mutual aid.

The purpose of *Education by digital technology* is to perceive digital technologies differently by using all the sensors and the functionalities supported by these intelligent tools. Even though they have not been designed for education, they can easily become pedagogical actors combined with play.

3. Impact of Education by Digital Technology on the Environment

Considering that the environment has an impact on pedagogy[6], if we create a new pedagogy, we must rethink the environment, the design of the school and the classrooms. This is also a principle promoted by alternative approaches: in Montessori classroom, there is a "prepared environment" and in Reggio Emilia approach, we talk about the environment as the "third teacher". These two pedagogical approaches promote *"an arrangement that facilitates movement and activity"*[7], "*a learning environment that makes use of our senses, invite curiosity and discovery, and foster relationships"*[8].

Indeed, by integrating new technologies at school, we change the spatial organization. As the teacher is not the owner of learning, *Education by digital technology* encourages numerous interactions between children, teachers and digital tools within the pedagogical environment. The environment should be stimulating, and the furniture must adapt to the different pedagogical scenarios, alone, in-group, with the teacher and so on.

As digital interfaces help to develop autonomy and solicitation of curiosity, the environment should be safe and, the child should feel free to move throughout the classroom, to freely use the tools that he needs. Furniture should be more flexible and easily movable from one place to another, and from one function to another.

4. Numerium

Numerium is my diploma project presented at ENSCI-Les Ateliers in October 2017. After several months of research about early childhood education and the use of digital and pedagogical interfaces, I have met many children, parents and teachers as well as early childhood professionals such as educators, paediatricians and speech-language pathologists. This meeting process has helped me to design the project, furniture and uses scenarios.

Numerium (from the French words: *aquarium numérique* which means digital aquarium) is a digital tools tank in which children are informed and educated, and where the borders allow screening and observation. With this device, we encourage children to use their whole body and senses to change their relationship with digital technology. It is not an alienation of the actual methods and tools, but an enrichment of the education generating new digital practices. I tried to create an innovative device without screen interface for kindergarten, a device promoting the development of the child's abilities. Each scenario is based on an active child's attitude, and then he becomes an actor of his own choices, an author of his own actions, in a changing world.

4.1. Furniture

Thinking by and for digital technologies, the furniture is flexible and mobile. Seat, bench or table, each module is independent in order to encourage modularity in the space of the classroom. We can also assemble the modules in different ways according to the different pedagogical scenarios—in circle or in line for example. Moreover, plans are available in open source, which allows schools to build their own wooden modules that can be assembled without nails neither screw.

4.2. Scenarios

These multi-actors scenarios attempt to develop the senses, especially hearing and touch, in a collective and playing environment.

4.2.1. Child-photograph

In this scenario, children are required to produce a collective piece based on photographs. Each child takes a photo of another child's body. With all the photographs, children can reproduce a body or a face.

Here, we are working on child's body awareness and the relationship between the individual and the collective.

4.2.2. Interactive Stories

This scenario is about telling a story associating sounds and movements, using CoSiMa[9] technology, developed by IRCAM.

Each child is equipped with a smartphone. At some moments of the story, children can reproduce gestures, generating sounds that illustrate the story. These gestures have been selected intuitively in order to ease their learning and their imitation by other children.

For this scenario, we have chosen the story of "We're Going on a Bear Hunt" for its dynamism and the imagination that the story can generate. The imagination is stimulated by the sounds produced by smartphones creating a particular atmosphere. It is a listening, memory and coordination work.

4.2.3. Tactile Atelier

In this tactile workshop, smartphones are hidden under materials in order to perceive the sense of touch associated to sounds and materials.

Thanks to the Scorpion application, also created by the CoSiMa team of IRCAM[10], a "caress touch" activates the sound of the smartphone. Rough surfaces are associated to high-pitched sounds and, soft surfaces are associated to deep tones. Each kid owns a wooden tablet, and he must sort the materials according to their roughness and the sounds associated. This kinaesthetic atelier fosters the children's autonomy and mutual aid.

5. Education by Digital Technology to Education on Digital Technology

The Numerium project has been tested with a hundred children aged between 3 and 6 years old in different Parisian kindergartens. As the new French Kindergarten program includes the use of digital technology, teachers and children have been really motivated by the project. Even if some changes must be incorporated in order to make the project, furniture and applications, more efficient and customizable, this is the first step.

A vector of "Learning by doing", this Education must evolve toward an "Education on digital technology". Children are surprised by *"all the things that we can do with smartphones and tablets"*. They are really curious to know how the technologies work, to discover "*what it is inside the box",* and thus demystify these devices.

Therefore, we can imagine new pedagogical scenarios promoting education on digital technology. Learning to code is one of the scenarios in several schools around the world, but this is just the beginning... At the Centre for Research and Interdisciplinarity, and especially in the Motion Lab, we are currently working to introduce new pedagogical approaches where we teach to teachers and the children how to use digital interfaces. We apply the concept of "Research by practicing", so they can learn the methods and mechanisms of digital research.

Young digital researchers, designers and educators must work together to meet the challenges caused by the current anthropological revolution. Obviously, we should rethink about the School of tomorrow. We should not forget that the learning process starts at the very beginning of life; therefore, digital natives must receive an innovative education by and on digital technology, from a very early age.

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The Impact of Exogenous Urban Factors on Absenteeism and Dropout Rates

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Abstract

In the last decade, observation of the negative influence of various factors on the education system and their mutual interaction, attracted the special attention of scientists all over the world. Subjects of major interest are dropout rates (early leavers from the education system), correlation between school absenteeism and overall education outcomes. This makes the whole concept of "Equality of Educational Opportunity" questionable, including the role that the government and private sectors should play in reaching the goal. Without ignoring the school or the reality of the current education system, it is necessary to identify exogenous factors and understand the role they play in the problem expansion process because the loss is multiplied and felt by parents, schools, pupils and society. Poorly educated people limit economies' capacity to produce, grow and innovate. Failure in school damages social cohesion and mobility, and imposes additional costs on public budgets to deal with the consequences of higher spending on public health and social support and greater criminality, among others. Exogenous factors influencing school attainment are not under direct jurisdiction of policy makers, and since capital investment creating the educational system context makes a significant impact on the disposable budget, they should be able to deliver visible improvement to the system and create lasting, countable positive effect on the users, in order to reach effectiveness. For that matter, it is necessary to explore their hidden influence to form a more holistic approach to enhance education attainment level rates and quality of overall output.

1. Preamble

The wider context of interest in the present issue stems from recent globalization-driven change within economies. Globalization presupposes deregulation, liberalization and privatization, leading to increasing economic integration between countries with a series of negative phenomena. Since global competition is changing the rules of the market playground within each industry, the key to successful competition no longer lies in the establishment of an economy of scale, low cost production and/or cheap labor force input, but rather switches the focus to new technologies and innovations that create products and services of higher added value. Such products and services have a relatively small share of material components (raw materials, energy, physical labor etc.) and a large percentage of knowledge-based capital, improving better resource allocation that adds a new value to the final product. The economies thus are becoming less raw material and energy-dependent. With respect to products and services belonging to high and generic technologies underlying research and development, scientific activity and education, they are becoming strategic resources of the national economy. In other words, intangible factors, such as research and development, and education or human capital, stem out of the factors of consumption, to be the fundamental raw material and production resources.

The most common example referred to for illustration of the impact of knowledge on economic development is a comparison of the development of South Korea and Ghana. Both countries had the same GDP per capita in 1960s, around $700 U.S. dollars, and they were on the verge of starvation. In 2015, just about fifty years later, South Korea had $28871.57 U.S. dollars per capita, achieved through the high speed industrialization process, technological transfers and investments in research and development. In 2013, Korea ranked second in terms of R&D investments, and 80% of the budget came from investments by large enterprises (*cheabols* like Samsung, Hyundai, LG), while 20% came from the state.

With economic growth comes economic development of society. Strategic and economic development policies of highly developed countries contribute to knowledge and intellectual capital formation.

2. Education

Since the education system provides the knowledge necessarily needed to each and every sector of the economy, it must participate in the redistribution of the economy's newly created value. There is a manageable difficulty in idea procurement and this is because education always plays the "middle-phase product" role and monetary expression of the output created is not easily defined. Therefore, the assessment of its real value, as well as the allocation of related resources from the Gross Domestic Product, stem from the decisions of competent authority-holders of educational policies.

In the process of formation of education policy, special attention is given to quantification of size and impact of relevant, system defining elements at the micro level. Those elements tend to be influential, accountable and relevant indicators of a system's endogenous and exogenous factors and instrumental elements of its inputs.

Direct control or manageability of endogenous factors is disabled by the fact that they are acting and are formed outside the system. In order to mitigate their negative impacts on educational achievements, it is crucial to establish and implement a holistic system policy based on the conclusions derived from considerations and analyses of their operating trends.

The exceptional significance of exogenous factors, in turn, is highlighted by the direct (running) jurisdiction of educational policymakers on top of most of them. Setting up a basic scientific question from the aspect of effectiveness, what makes education policy implementation inside one country more effective when compared to another, if both of them have a similar system setup

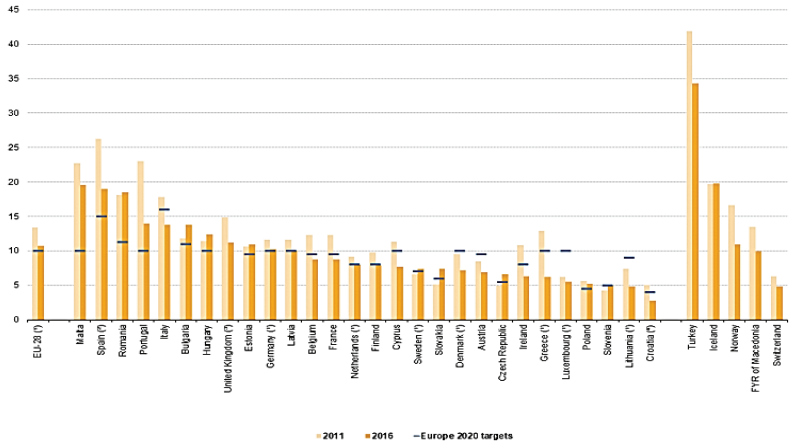
and their funding is almost the same? Is it the influence of factors grouped by specific attributes at the country level, or are those groups formed at the lower levels— city, schools and/or students? This seems to be an extremely important factor to consider from the aspect of joint investment in improvement of the system.

Many studies have been conducted in order to form a relevant answer to the question above, but none of them takes a holistic view. That's firstly because they use differently defined set of data, in different time periods, including varying elements.

2.1. Negative Impact of Exogenous Factors on the Education System

In the last decade, observation of the negative influence of various factors on the education system and their mutual interaction attracted the special attention of scientists all over the world. Subjects of major interest are dropout rates (in EU referred to as early leavers from the education system), correlation between school absenteeism and overall education outcomes. This makes the whole concept of "Equality of Educational Opportunity" questionable, including the role that the government and private sectors should play in reaching the goal.

2.1.1. Dropout Rates



Note: breaks in series.
(*) For the target to be achieved, the share of early leavers from education and training should be below the target value.
(*) Europe 2020 target is defined as the school drop-out rate.
(*) No Europe 2020 target.
(*) 2016: low reliability.
Source: Eurostat (online data code: edat_lfse_14)

Since the dropout rates have been on a rising trend over the past decade in a significant number of elementary and high schools, this problem has been placed as the focal point of the future challenges of international education policy consideration. While some countries such as the United States and Canada have found and have successfully implemented dropout rate reduction policies, a significant number of countries over the last five years, including Romania, have not been productive yet. According to Eurostat data, every year, nearly 6 million pupils (in EU countries) leave the school for unknown reasons, which makes almost 14% of the entire population. That is the leading reason for listing the 10% dropout rate as the goal of the strategic development plan made for the period up to 2020.

Looking at the dropout rates in schools of Republic of Croatia, it is evident that they are very low, around 4%. But on the other hand, comparing their levels in 2008 and 2013, the increasing trend is evident, above the limit prescribed by the 2020 strategic development EU plan. The Eurostat database contains a note that states that the interpretation of the data for Croatia requires caution, because the data was collected using a methodology significantly different than those used among other Member countries. New methodological plans in Croatia has not been realized yet.[1]

2.1.2. School Absenteeism

Another important negative and significant aspect of the educational system is represented by rising rates of school absenteeism. The correlation between school absenteeism rates and poor educational achievements is strong and positive. There are many ways scientists tend to explain the phenomenon, but very few of them offer some solution. Research has outlined that the highest measured absenteeism frequencies are those of the first year of high school pupils[2], while the absenteeism rates continuously grow through the schooling period till the last grade, but slowly[3]. One other important reason for students to skip classes can be found in the school environment, often significantly associated with fear of school, feelings of incompetence, dissatisfaction with choice of school program and the perception of inappropriate teacher behavior[4].

Without ignoring the school or the reality of the current education system, it is necessary to identify exogenous factors and understand the role they play in the problem expansion process because the loss is multiplied and felt by parents, schools, pupils and society. Poorly educated people limit economies' capacity to produce, grow and innovate. Failure in school damages social cohesion and mobility, and imposes additional costs on public budgets to deal with the consequences of higher spending on public health and social support and greater criminality, among others.

2.2. Identification of Influential Exogenous Factors

As Adam Smith already outlined, there is something naïve about the mere usage and consideration of correlation of education budget, its supply and demand, with educational achievements, school absenteeism and/or dropout rates, since correlation is not necessarily causality (Rumberger and Lamb, 2003; Business Council of Australia, 2002)[5].

In this context, it is possible to set a hypothesis that pupils dropping out of the educational system or having a low educational achievement have not been recognized as part of bigger social issue, but as individuals with family issues, implying that weak economic, cultural or educational family attributes create bad circumstances for growth and education of the pupil (Coleman, J.C.

1988; Coleman. 1966; Ma Wilkins, 2009; Rubin Balow, 1979; Sutton Soderstorm, 2001; White, 1982, Sirin, 2005). Background data used as affirmation rely on the fact that those families are often socially marginalized, and their problems do not become the subject of wider public interest.

2.2.1. Socio-economic Factors that Affect the Characteristics of the Education System

Numerous studies looking into the source of distinction between schools have generated a conclusion suggesting that the backbone to educational achievement arises from family, socio-economic backgrounds, thereby forming different atmosphere in different schools. Since the families with stronger background enjoy better reputation, they have support of the local community, contact with enhanced professors, professors with higher ethics, improved cooperation with teacher and an environment surrounded by minor disciplinary problems, a higher level of competence and cooperation among pupils, and schools with better atmosphere directly affecting chances for educational achievement and success.[6]

However, such interpretation of a strong correlation requires more and more explanations of causality today, since worse educational outcomes, such as the decision to quit schooling, may be influenced by exogenous factors of school environment, or even be produced directly by failure of the system, and not exclusively by the factors inherent to population of individuals who have dropped schooling.[7]

Dropping out of school, as the phrase suggests, is a process. It cannot be observed as a separate moment or event in which the pupil drops out of school, because it comes as the result of overall dynamics of the development of aggravating circumstances, composed of unfavorable factors on pupils at the personal, social and institutional levels. More importantly, the constant growth of absenteeism rates, which have been attributed to lower educational achievements, initiates "significant impulse" that helps develop the trend.

2.2.2. School Factors that Affect the Characteristics of the Education System

In the analysis of educational achievements, an important place is occupied by school attributes. As third of the four most important social institutions—State (national economy), family, school and church—it has a significant impact on the formation of "Equality of Educational Opportunities" and overall social inclusion.

Table 1. List of Influencing Factors

School Type (including the pupil group composition)	
If pupils are selective and independent with a high ability to execute tasks and overbear difficulties, the dropout rate is low.	Scientific contribution was made by: Okpala et al. (2001), Balfanz and Legters (2005), Smith and Naylor (2005), Dustmann and van Soeast (2008), Dalton er. al. (2009)
School Resources	
Higher the pupil to teacher ratio and more pupils in class, the higher the risk of dropping out.	Scientific contribution was made by: Pittman (1993), Balfanz and Legters (2005), Rumberger (2004a)
No effect independent of, for example. teaching practice and pupils' age	Scientific contribution was made by: Smeyers (2006)
School Politics and Practice	
The experience of teachers, expectations, support and the quality of class teaching: the higher they are, the lower the risk of students giving up/dropping out	Scientific contribution was made by: Finn (1989), Adams and Becker (1990), Herbert and Reis (1999), Blue and Cook (2004), Dalton and Ostali (2009)
School social capital: if it is positive and has a strong cohesion, the risk of students giving up/dropping out is low.	Scientific contribution was made by: Pittman and Haughwout (1987), Finn (1989), Herbert and Reis (1999), Australian Business Counsolor (2002a), Blue and Cook (2004)

Source: composed by author, based on literature reviewed and read

According to push-out theorists, students' individual attributes do not completely account for the decision to leave school. Instead, a combination of individual and school attributes influences them to leave.

2.2.3. Effects that Arise from Pupils' Nationality

In Europe, the year 2015 will arguably be remembered as the year of the 'refugee crisis' when more than 1 million people (100,000 children) entered the European Union (EU) in search of safety and a better life. And it was only the beginning. An estimated 362,000 refugees and migrants risked their lives crossing the Mediterranean Sea in 2016 and over 105,000 in the first half of 2017. The first consequences of the "shock" started to manifest and change the social environment. The EU started to analyze and anticipate the consequences. Historical case studies are being revisited in order to find appropriate answers and to avoid unnecessary problems.

Substantial and continuous influx of refugees and asylum-seekers is likely to increase the number of students with migrant background in European classrooms, at least in the short to medium term. A necessary consequence of the growing student body, in the long term, will be high pressure on the education system (mostly because it requires investment of additional efforts in the teaching process, requiring the teaching of new foreign languages). In addition, the educational achievements of students with an immigrant background tend to be lower than those of native students in most OECD countries and the difference in some countries became equivalent to 1.5 years of schooling. At the same time, the immigration crisis has offered a number of significant opportunities to European higher education since it has increased diversity and created a new opportunity to achieve higher rates of inclusiveness, creativity and openness.

The results of the previous surveys (such as the European Social Survey/ESS/and Citizenship, Involvement, Democracy/CID/) show that in most countries a substantial number of respondents consider their ideal neighborhood as one that does not have residents who are ethnic minorities. Multilevel regression analysis performed by Moshe Semyonov, Anya Glikman and Maria Krysan on resulting data, reveals that preference for place of residence as a response to its ethnic composition is significantly affected by both individual-level and country-level characteristics. At the individual level, preference for ethnically homogeneous residence tends to be more pronounced among socioeconomically weak and vulnerable populations, conservative populations, and individuals who reside in communities without ethnic minorities. The country-level analysis demonstrates that preference to live in neighborhoods without ethnic minorities tends to increase with the relative size of the non-European ethnic population and to decrease with economic prosperity.[8] Impact of such attitudes, especially in European countries (EU states), results in the perception that immigration is a threat to national integrity and economic development. Immigrants tend to get credited for the subversive role, a negative presentation and get stereotyped (Quillian, 1995; Citrin i dr., 1997; McLaren, 2003; Sniderman, Hagendoorn i Prior, 2004; Sides i Citrin, 2007)[9].

Assimilation of immigrants is a particularly delicate issue when considering the most vulnerable groups— children. Conclusions of scientific papers that have been focused on educational achievements of immigrants and racial minorities report contradictory findings. Studies in the US and Australia especially suggest that being black, Hispanic/Latino or indigenous, rather than Caucasian, increases the likelihood that one leaves education early. On the other hand, in this context it has been suggested that hailing from the Asian/Pacific descent decreases this probability (e.g., Bynum and Thompson, 1983; Ekstrom et al., 1983; Business Council of Australia, 2003b; Ishitani and Snider, 2006). Over the past few years the gap between white and non-white youths has closed, albeit slowly and rather more among females than males (Kaufman et al., 2004; Dalton et al., 2009; Cataldi et al., 2009). However, other scholars contend that race and/or ethnicity do not have a significant effect which once accounted for factors such as family background and student characteristics (e.g., Rumberger, 1983; Balfanz and Legters, 2004; Plank DeLuca and Estacion, 2005; Entwisle et al., 2004 and 2005; DesJardins et al., 2006).[10]

Of course, a greater concentration of immigrants and racial minorities in certain geographical locations raises the risk of lower educational achievements. Confirmation of such notation has been established by the scientific research of Williama Juliusa Wilsona (1987) in the U.S.A. The aim of the study was to investigate the differences between the educational accomplishments of blacks and whites, and the results highlighted the importance of the environment individuals live in. Black people, due to lower educational achievement, have lower disposable income and are living in poorer urban areas (among other things, because of lower apartment rents) which typically show a greater tendency towards criminal activities, high unemployment, low activity rates and consequently enjoy lower quality of life conditions. On the other hand, white people living in heterogenic surroundings in coexistence with the poor as "members of the lower middle class", who were richer and lived in pleasant atmosphere, saw better educational outcomes.[11]

Last but not the least, scientific research considers the time elapsed since immigration as a key variable. For example, Brisboll (1999) and Vizcain (2005) conducted research analyzing NELS: 88 data, and the conclusion denied a greater chance of early dropout of pupils who recently immigrated (Hispano-Americans, Latinos) emphasizing a higher chance of early education dropout, surprisingly, for the third generation of immigrants. In contrast, Blue and Cook (2004), Cataldi and others (2009) pointed out that the rates of giving up education are lower and better educational results are achieved by the minority groups of pupils who were born in the U.S. than from those who are of the second generation or beyond.

But in reality, the so-called refugee crisis offers a significant number of opportunities and challenges to the European higher education system. Huge numbers of young people thirsty for higher education and knowledge can significantly boost student numbers in their host countries.

2.2.4. Urban Factors Influencing the Educational System

In the educational system, spatial distribution of educational institutions has become the subject of particular interest. Due to the fact that costs of construction are quite high, decision regarding building of institutions takes into account a number of parameters like the population density, current existence of similar or complementary objects, complexity of basic infrastructure construction work, etc.

Measured by the *Legatum Prosperity Index* (2015), the Republic of Croatia has been ranked as 41st out of 142 countries of the world, in the indicator that measures the efficiency of the education system through three categories: availability, quality of education and human capital. Only availability can provide the chance for the enhancement of personal potentials and development and finally, for overall social productivity. In addition to the ten new EU Member States, only Bulgaria and Romania have achieved

a lower index. It is an obvious indicator that a lot can and should be done in order to improve the efficiency and effectiveness of the educational system that should be considered a permanent task in social improvement.

Primary education is guaranteed to each individual by Article 26 of The Universal Declaration of Human Rights (UDHR), which was adopted at the General Assembly of the United Nations back in 1948[12]. The availability of secondary education is characterized by excluding character, burly by its limited presence within each block of the local units and significant differentiation of high school programs, aiming to form educational specializations within the local units and countries. The direct consequence is higher exposure of pupils' educational achievements, their absenteeism and dropout rates to the influence of exogenous urban factors. Records of evidence and a defined impact of such factors, with enabled management properties at local governmental level (governor of decentralized function of secondary school system), present the realistic predisposition for affecting the overall educational system and achievement (of economic) efficiency.

Scientific literary opus shows that local units' blocks or geo-location of residence of pupils' families, considering the associated potential problems with housing, a lack of playgrounds and green surfaces, either directly or indirectly, have a crucial impact on the educational success of pupils. A poor and unhappy environment stimulates a student into leaving school early[13]. And just how "degree of urbanity" of local units can be correlated with weaker educational achievements and higher rates of school absenteeism, the entire region in which the pupils live can be associated with higher dropout rates. This was the case, for example, in the South of the USA. In addition, the overall educational attainment according to research is directly related to the "degree of urbanity" of the environment in which the schools are located. These are the findings of scientific research conducted by Aston and McLanahan (1994), Haveman et al. (1991) and Swanson and Schneider (1999), who point out that deterioration of the education system is connected to a higher degree of urbanity of the environment in which the school is located. However, such findings are not unified. On exploring the work of Rumbergera and Palardya (2005), we found out that even the correlation of variables was not successfully verified. Then, the results of the quantitative research of McMillana and Marx (2003) demonstrate that educational achievements of pupils in rural areas tend to be significantly weaker.

All these factors together lead to the conclusion that specific surroundings produce specific results. The influence of urban factors on educational attainment (absence, dropout rates) is summarized and shown below:

Figure 2. Deterministic influence of urban factors on educational attainment and pupils' achievements

Source: Author's own. Data from the U.S. National Center for Education Statistics (NCES)

The influence is determined as follows:

- When considering the importance of transport infrastructure, first of all, it is important to emphasize that the efficient organization of public transport networks is under the direct jurisdiction of the gravitational part of the local community. Special attention is required and needed for persons with disabilities, who represent over 12% of the total population of the Croatian society.
- Physical infrastructure investments, in turn, are mostly related to coverage of construction costs and maintenance of infrastructure facilities. Such investments contribute to desirable local units' living conditions, attracting existing enterprises and encouraging establishment of new enterprises on their territory. Also, they make a contribution to raise the potential of market land value and improve the overall quality of life in local areas. Effects of that influence manifest through lower emigration numbers, low dropout rates and enhanced development perspective for community. Areas considered as infrastructurally inferior tend to have a higher risk of poverty and social exclusion (i.e., which necessarily links rising dropout rates and/or lower educational achievements).

2.3. Imposed Conclusions on Exogenous Factors

The landscape of education is changing day by day. But some problems seem to be persistent or even getting worse over time. These concern the "Equality of Educational Opportunities", combined with overall "Equality of Life Chances". It is widely accepted that educational opportunities for children ought to be equal, and the fundamental significance of educational opportunity to many important social issues today caught the interest of the wide scientific community as well as governments all over the world, trying to devise a good, inclusive, available quality education system. Social scientific advances in recent years have clarified our understanding of the mechanisms behind children's unequal access to educational opportunities, and the consequences of those inequalities for social mobility (e.g., Chetty et al. 2014; Duncan & Murnane 2011). This knowledge enables policymakers to target interventions and change the approach of system systematization.

As it can be seen, most of the problems with school attainment and overall educational achievements are being born in materially deprived surroundings. Since education is the most effective tool to fight the poverty and social exclusion, there comes the problem of causality. In such surroundings, education attainment rates are lower, final educational achievements are worse, individuals are weaker to fight poverty and continue to develop deprived surroundings.

So, taking into consideration the elements outside the system—urban factors, such as transportation routes, number of active enterprises, social infrastructure concentration, and those defining the "degree of urbanity", it all comes down to availability. Shorter "to school" distance, higher number of school peers, higher number of business enterprises (related to greater chances to work and earn), better equipped schools, it can be seen that healthier surroundings produce better school outcomes.

3. Policy Recommendations

Since the main obligation of the government is to provide equal chances for each and every citizen, even though there's no simple or unique solution, there are some measures that should be taken into account.

1. For starters, considering the availability, social services should be equally distributed among the citizens. There are several ways to make education system more (fairly) available to the children—ensured free settlement in high school dormitories, empowered usage of e-learning systems and ensured smarter transportation roots.

   High school dormitories help to optimize school institutions distribution. Local units with lower school population density can be grouped and centered on one campus/dormitory, should build and develop stronger pupil culture, create a safe community for high school pupils, providing the structure necessary for higher achievement. Such measures generally reduce costs, and produce better outcomes.

   Considering the measures of improvement of the educational system, as any other social policy system, it is important for the government to maintain a close watch on non-school fees payments by parents that have the potential to increase the unsustainable levels of availability by most households, especially in rural areas.

   Then there are e-learning programs, affecting the quality of education in many ways. E-learning, considered to be a novel way of learning, encompasses all learning and teaching ways backed by technology (Leypold, Nolting, and Tavangaran, 2004) and includes all definitions related to increasing the availability of sources, flexibility of the learner, and the expansion of skills as well (Lowenthal, Willson, and Parrish, 2009). It rises above the infrastructure availability, increasing the potential to share knowledge fast and easy and to skip the socio-economic, gender, culture, language and other "background" differences among pupils.

   Then there are transportation issues. Children traveling to school tend to have less time to study, do not participate in extracurricular activities and focus predominantly on academics, and finally tend to avoid the school and have lower achievements. Therefore, planning the transportation from home to school should be considered at an aggregate level. Sometimes, the cost of transport subventions is higher than the construction of new schools or dormitory buildings, and governments must be able to provide the best solution for each and every child, since the cost of uneducated citizens imposes multiple developing restrictions and costs derivations in the long term.

2. Policies and programs concerning adult education should be encouraged and rolled out by governments in each part of the country. The importance of adult education is envisaged to aid in enhancing attitudinal change among illiterate and ignorant parents in favor of child education.

3. Consider the curriculum quality. A more innovative, authentic and intellectually stimulating curriculum for students in situations of risk is needed. Analysis of successful schools and programs shows that smaller schools can easily target and recognize pupils at a risk of dropout and give special attention to them, while, as Lamborn et al. (1992) emphasize in their work, there is clear evidence that participation in after-school activities encourages pupils to remain engaged no matter what the school size. Perhaps, a way to encourage the engagement of young individuals in high school is to provide them with different alternatives and let them choose part of their educational process. Concentrating on the "core" rather than "all" subjects of curriculum may reduce the feeling of incompetence or lack of interest and additionally make it possible for schools to innovate, and/or meet the community's special demands,

But, because of the complexity, this is a topic that needs to be discussed further.

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SECTION 5

MIND, THINKING AND CREATIVITY

A Brief History of Mind and Civilization

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Abstract

The rational mind is the highest evolved status of human consciousness. The evolution of mind and civilization has proceeded hand in hand for millennia. The development of new capacities of mind made possible the development of tools, language, agriculture, permanent settlements, towns, cities, religion, trade, transportation, communication, government, law, money, literature and the arts, education, nation states, scientific and technological research. So too, each stage in the development of civilization has shaped the evolution of the human mind and its faculties and the way they are applied in life. The limits to our knowledge and accomplishment reflect limits to our rationality and the utilization of our mental potential. Our knowledge consists of fragmented, piecemeal, compartmentalized theories, when the reality we seek to understand is inclusive, complex and integrated. Our conceptions are based on mechanistic, static, inflexible equilibrium models, whereas the world we live in is alive, dynamic, organic, conscious, responsive, creative and continuously evolving. Our science assumes the poise of an impartial observer of objective reality, whereas all knowledge without exception is colored by the subjective perspective of the observer. Our science strives to be neutral and value-free, whereas the knowledge we need should help us realize universal values. We need to evolve ways of thinking that reunite the objective and subjective dimensions of reality and reflect the integrality, dynamism and vibrancy of evolutionary nature. That is the challenge and adventure before us.

1. The Paradox

The advance of knowledge over the past two centuries has been awe-inspiring. Our understanding of the physical universe and our own evolutionary past now extends millions of light years across the universe and billions of years back in time. Our capacity to measure and process data, transmit and disseminate facts, formulate new concepts and ideas, discover and invent, organize and educate, create and imagine, and harness the forces of Nature for human ends has multiplied exponentially.

Knowledge is power and never before has humanity known so much about the world in which we live. Yet never before have we faced challenges of such unparalleled magnitude and complexity, which defy solution by existing knowledge. Our progress has had unintended consequences. Efforts to develop a truly global civilization on the foundations of science and technology have been accompanied by rising levels of economic insecurity, political turmoil, social unrest, displaced populations and environmental instability. Our economic system leaves billions in poverty and promotes widening inequalities. Our mechanical inventions displace, alienate and dehumanize us. We are dominated and oppressed by the monetary system intended to enhance human security. Our inability to establish effective instruments for democratic global governance leaves us powerless to address the existential threats posed by nuclear weapons and climate change. Our way of life ravages the Earth. In spite of ever increasing knowledge, our sense of uncertainty and insecurity is increasing. In spite of ever greater power of control and mastery over the forces of physical nature, there is an increasing sense of powerlessness to control the forces we have unleashed and the future course of our own evolution.

Concerted efforts are being made at the national and global levels to address each of the political, economic, social and ecological threats confronting humanity in the 21st century. New policies have been applied to enhance control. New institutions have been created to improve coordination. Yet these efforts have been largely ineffectual and often counterproductive. A quarter century after the end of the Cold War, political tensions are on the rise and nuclear weapons continue to proliferate. The recent flood of refugees into Europe threatens to undermine decades of progress toward European unity. In spite of unprecedented inter-governmental coordination, global financial markets remain unpredictable, unstable and uncontrollable, and multinational corporations increasingly operate beyond the reach of national governments. In spite of institutional and policy initiatives at the national and international levels, all of these problems appear to be growing. No effective solutions are in sight to counter the rising number of unemployed youth and displaced migrants, the spread of nuclear weapons, depletion of soil and water, the drug trade, cultural conflicts, terrorism, and climate instability.

The World Academy of Art & Science has traced the roots of these multiple challenges to a common set of underlying factors. They are all global in nature and defy solution at the national level. They are all interrelated and defy solution by fragmented, piecemeal sectoral strategies. They are all the result of rapid globalization in the absence of effective institutions for global governance. They are all impacted by the increasing difference in the pace of technological innovation and cultural evolution. They are all perpetuated by outdated social institutions. As Canadian mathematician William Byers insightfully summarized it, "What looks like a series of disparate crises is really one crisis that manifests itself in various ways—one all-encompassing crisis that arises from inner contradictions that are inherent in modern culture."[1]

Research by the Academy has led to the conclusion that these multiple crises are the result of three deeper root causes. First, they all reflect the limitations of prevailing knowledge in the social sciences. The failures of policy measures and institutional reform reflect the insufficiency of our understanding about how human society grows, develops and evolves. This has led WAAS to conclude that a radically new paradigm in thought is needed to support a new institutional and policy framework founded on the values of human welfare and well-being.[2] For the past five years WAAS has been promoting initiatives to foster new thinking on

human-centered economic theory, on a conceptual framework for a comprehensive paradigm for human development encompassing all dimensions of social existence, on basic principles of a transdisciplinary, integrated, value-based science of society, and on the unique catalytic role of the individual in social development.[3,*]

The second conclusion from this research is that the present crises are a result of the current distribution of social power in the world. Theoretical knowledge of society is incomplete so long as it fails to comprehend the way in which social power is generated and distributed. Social power refers to the cumulative capacity of society to accomplish whatever goals it aspires for. Never before has humanity possessed so much power—power to interact, communicate, exchange, transport, produce, discover, invent, educate, experiment, prolong life, entertain and enjoy. Yet never before has the distribution of social power and its fruits been as uneven and inequitable as it is today. At a time when society possesses more than sufficient capacity to ensure sufficient food, clothing, housing, education and health care to meet the needs of all human beings, billions of people still struggle for bare survival. Existing social institutions and policies have failed to remedy the situation and existing economic and political theories largely ignore this underlying problem. This has led WAAS to initiate an inquiry into the theoretical and historical origins and determinants of social power.[4]

Third, and most importantly, this research has led to the conclusion that all these causes are themselves founded on a more fundamental cause arising from the way modern society has developed the faculties of the human mind. The crises confronting civilization today are rooted in the way we use our minds—in the way we think.[5,6,7]

2. Mind

The basic premise of this paper is that the course of human civilization has been the result of fundamental evolutionary advances in development of the human mind, its faculties and powers for knowledge and conscious action. The central thesis is that the dilemma confronting civilization in the 21st century reflects inherent limitations in the specific way in which modern civilization utilizes the powers of mind; namely, that the present combination of analytic and systems thinking in concert with mathematics and the scientific method is inadequate to comprehend and effectively deal with the root causes and complexity of the challenges we face. Moreover, the institutional and social authority presiding over the present intellectual framework has itself become a major impediment to the formulation of more effective knowledge, particularly in the human sciences. The central conclusion of the paper is that we need to consciously strive to enhance our understanding of the characteristic ways in which we think, to increase our awareness of the inherent limitations and blind spots generated by those characteristics, and to develop the capacity to think creatively in a more comprehensive and integrated manner outside the confines of the existing conceptual framework.

2.1. Mind, the Instrument

Mind is humanity's most developed instrument for knowledge of self and world. Like every other instrument, mind has certain capacities and is subject to certain limitations. Science has expanded our knowledge of the world around us by developing the microscope, telescope, X-rays, chronometer, spectrometer, computer and an endless variety of other tools. In each case it has discovered both the utility and the limitations of these tools, the range of their effectiveness, the distorting factors that influence their accuracy and the inherent limitations to their power. Knowledge about the characteristics of each instrument is essential for using it appropriately. Modern civilization is founded on the primacy of scientific discovery. Minute attention is focused on the procedures and processes for validating scientific hypotheses and developing new instruments to extend the reach of our senses and the computational capabilities of mind, yet very little attention is devoted to learning more about the creative processes of mind itself, which are the source of great scientific discoveries. Having utilized mind as our principal instrument of knowledge for thousands of years, it seems ironic that there is so much about the nature, functioning, and limits of the mind and its faculties that we have yet to understand.

Our preoccupation with using the instrumentation of mind has nearly eclipsed serious inquiry into the nature and operation of mind itself. Neuroscience has recently made significant strides in understanding the structure and functioning of the human brain and its relationship to memory, sensory and motor functions. Computer science and artificial intelligence have discovered how to mimic certain mental capacities, such as memory and computation. But our understanding of fundamental processes of conscious awareness and knowing, self-consciousness, thinking, reasoning, insight, creativity, willing and decision-making remains rudimentary. Indeed, we still lack even a clear definition or conception of what mind is, the myriad faculties it possesses, the various types of thinking that characterize human cognition, and the other processes it consciously utilizes for knowing and willing. Consciousness determines power. We cannot have mastery over that of which we are not conscious. This paper examines the relationship between the way we utilize our mental faculties, most particularly our faculties for thinking, and the course of development of civilization.

This brief history of mind and civilization traces some important stages in the evolution of our capacity for thinking and its impact on the type of knowledge we have acquired and the development of civilization. It covers the broad sweep of human history in an impressionistic, anecdotal manner, highlighting landmarks central to the argument and ignoring others that are not central to the thesis being developed. An effort is made to draw particular attention to aspects that seem most relevant to the present and likely future stages of our mental and civilizational development.

Mind excels in a linear, step-wise, chronological analysis of unidimensional processes in the physical world. However, it is unlikely that the process we are attempting to trace is linear in its development. For it occurs on multiple levels of our existence, involves complex interactions between innumerable factors, alternating between progressive and regressive movements. The actual

* See World Academy of Art & Science project site on New Paradigm http://www.worldacademy.org/new-paradigm?quicktabs_new_paradigm_main=0#quicktabs-new_paradigm_main

evolutionary process is far more complex than any description of it. A major source of this complexity is the fact that our existence contains both objective and subjective dimensions—the world around us and the world of conscious awareness and activity within ourselves. These two complementary dimensions sometimes develop in tandem and sometimes in apparent opposition to one another—subjective belief claiming sovereignty over our knowledge of the material world or apparent material fact dictating the terms of reality for our psychological self-experience. The history of civilization seems to fluctuate between these extremes, reacting periodically to restore the balance. Thus, a narrative of mind and civilization is a dance between our inner and outer worlds.

Another complicating factor is that we live and act on three planes of existence. Apart from sensations, actions and events that occur in the physical plane, human beings are aware and act simultaneously in life or vital plane in which we perceive, relate, interact and react nervously and emotionally with our environment and with other people. We also exist in a mental plane of facts, thoughts, opinions and ideas in which we observe, conceive, understand, create and decide. The evolution of mind occurs simultaneously in all these three planes. As civilization transits through different stages or phases of development, it also undergoes shifts in the relative emphasis it places on each of them. Ancient Indian culture organized its thought and life around spiritual truths. Hellenic culture centered on the mind and its conceptual ideas. Modern society is preoccupied with the application of mind to the physical world and society by means of technology. Humanity's understanding of its place in the universe, of our relations with one another, of our own psychological processes and capacities for knowledge are continuously evolving. This historical narrative will examine significant developments in relation to all three planes and the interactions between them.

The application of mind for the development of civilization has occurred in four major spheres of social activity that are expressions of four interrelated components of the human mentality—the capacity for conceptual thinking and logical reasoning; the capacity for ethical thinking and moral discrimination; the capacity for aesthetic creativity and appreciation; and the capacity for physical design, practical organization and efficient application for execution of activities in space and time. Philosophy, religion, the arts, science and technology are civilizational products of these capacities.

3. The Conscious Thinking Animal

Mind is a faculty of consciousness. Human beings are distinguished from other animals by the development and progressive emergence of conscious mentality. Lower order species possess to a limited extent many of the characteristics that we associate with conscious mentality, including language, purposeful actions, specialization of function, organization, and development of tools. But the mental capacities and 'knowledge' other species possess are mostly in the form of subconscious instinctive behaviors driven by biological urges, rather than conscious learning processes and conscious volition. The language of animals appears rudimentary in comparison to the extraordinary diversity, complexity, versatility and richness of human speech. Other animals seem to lack the mental capacity for self-awareness and reflection on their own existence which is characteristic of human beings. Do apes ever wonder why they were born or what it would be like to be human? Animals learn but seem to lack the capacity to consciously pass on learning from one generation to another. Animal behavior and social existence remain relatively unchanged from one generation and one millennium to the next, whereas human beings have continued to evolve higher forms of knowledge and new forms of civilization.

The principal faculties of mind include conscious awareness, self-awareness, perception, observation, memory, symbol formation, thinking, judgment, imagination and decision-making. Each of these faculties can be further subdivided in innumerable ways. This paper focuses primarily on the faculty of thinking, and the characteristics of the various types of thinking human beings have developed for the pursuit of knowledge, and the relationship between the ways we think and development of human civilization.

Thinking in earliest times seems to have been narrowly focused on specific actions designed to meet specific physical needs and interactions with the physical environment. The capacity of human beings to conceive of and fashion tools and instruments represents a rudimentary form of thinking. The earliest known stone axes were made 2.7 million years ago. Evidence of campfires are about 790,000 years old. Constructed dwelling places date back to 350,000 BC. Blades, needles, grindstones, paints, fish hooks, spear points, harpoons and mining instruments appeared in succession before 50,000 BC. The needle is of particular significance because it made possible fashioning of tightly fitting warm fur garments that in combination with fire enabled early Homo sapiens to survive in very cold northern climates such as Siberia, which eventually became the land bridge for the peopling of the Americas about 25,000 years ago.[8] These inventions demonstrate that early man had the capacity to translate conscious thoughts into action by a process referred to as decision or will. The development and spread of tools are indicative of what Merlin Donald calls mimetic thinking. Early man learned to cooperate and coordinate their activities as members of social groups. They learned from one another by example before the advent of spoken language facilitated oral communication and transmission of knowledge.[9]

Apart from these physical preoccupations, no evidence is available to determine at what stage early human beings began to reflect on the factors that differentiated them from other animals, the reason for the changes of season, the morality of their actions, their own mental and psychological reactions, or the purpose of their lives on earth. These higher forms of reflection required the prior development of language with a sophisticated vocabulary, concepts and ideas.

3.1. Symbolic Thinking

Mind has the capacity for pure self-awareness. We know that we exist without the intermediacy of senses or even of thought. But the faculty we call thinking is a form of indirect knowledge. Our mind receives sensory data about the world around it, interprets that data and derives knowledge from it. It hears a loud cry, identifies it as an animal, and analyzes it to determine whether it is that

of a prey or a predator. The data of the senses is distinct from the objects of sensation and the knowledge derived is distinct from the data. It is indirect knowledge. "Mind can only have the direct consciousness of self in the moment of its present being; it can only have some half-direct perception of things as they are offered to it in the present moment of time and the immediate field of space and seized by the senses. It makes up for its deficiency by memory, imagination, thought, idea-symbols of various kinds."[10] We try to identify and judge the subjective intentions, mood, and capabilities of another human being by their behavior, expressions and gestures. We have no direct capacity to perceive their subjective state.

Thinking is also a separative form of knowledge. The thinking mind does not directly perceive reality. It perceives thought-forms and formulates thought-symbols representing reality but separate from it. Physical sensation and experience impact on mind in the form of mental energy. The loud cry of an animal generates a mental sensation that activates the mind to full alertness. But until the mind interprets the sensation and identifies it as friend or foe, it does not possess knowledge. As soon as it recognizes the sound as the roar of a lion, it converts the energy into a mental form, a thought expressing the danger of an approaching lion. Then and only then does it also possess the capacity to transmit that knowledge to other minds in the form of symbols, signs or words. All symbolic, theoretical, conceptual, scientific knowledge is separative knowledge. It is knowledge of symbols that represent reality, not reality itself. Relativity and Quantum Theory, medical diagnoses of disease and econometric model of markets are conceptual representations of reality, not reality itself.

Thinking is a symbolic form of indirect, separative knowledge. It may begin with the primitive symbolic representation of the forces of nature as images or sounds or gestures. Cave art dating back 30,000 years confirms the development of symbolic thinking long before the emergence of complex languages. Evidence from this period of the widespread worship of the mother goddess most probably signified belief in the unique power of women for procreation. This suggests that man had not yet realized the relationship between sexual intercourse and the act of child birth nine months later. The symbol of the mother goddess reflected the sense of wonder and power associated with the act of procreation.

Primitive man shook with fear at the occurrence of a solar eclipse or an inauspicious configuration of the planets because he took these events as powerful symbols relevant to his own life. Symbols became the means for the creation and perpetuation of powerful superstitions. Superstition is the subconscious formation of a relationship between two or more things based on the perception or imagination that they are related with one another.

Symbolic thinking ushered in a transition from utilitarian thought focused on gratifying immediate needs to cosmological speculation regarding the nature of reality. Merlin Donald terms this as the transition to the stage of mythic culture in which language was first used to create conceptual models of the universe, grand unifying syntheses.[11] The German historian Karl Gotthard Lamprecht and the Indian philosopher Sri Aurobindo both describe a symbolic stage of psychological development in which man felt a great Reality behind all life which he sought through symbols and symbolic thinking which pervaded primitive society's thought, customs and institutions.[12]

These symbols were often laden with immense power. Historian Peter Watson identifies the idea of God as one of the three most significant acts of cognition in the long evolution of civilization.[13] Thus, numbers acquired mystical significance in many ancient societies as symbols of fundamental truths of existence, long before the rational mind had developed either the understanding or the linguistic capacity to render these truths into words. In Vedic India, intuitive knowledge of human consciousness and the universe was rendered into myths and symbols of profound insight, remarkable beauty and power, unintelligible to the modern intellect trained in analytic discourse. It seems likely that they were the result of intuitive faculties of mind that are no longer well developed or may one day yet become far more prevalent, as the capacity to read, write and calculate was at one time a rare endowment and considered a sign of genius. The brilliant Indian early 20th century mathematician Srinivasa Ramanujan regarded zero as the symbol of God, the apparent nothingness and unmanifest potential from which all emerges, and infinity as the deployment of that potential in creation. In the period of the Upanishads, symbolic images developed into symbolic words born of intuition, rather than rational thought. They sought to depict truths of existence rather than to describe and explain them in rational terms.

In fact, all words are symbols. All thoughts, concepts, theories and models are symbols. They are mental forms or images utilized by mind to represent reality, never reality itself. Today we utilize the same symbolic capacity of mind to infuse power into a currency note, a wedding ring, a policeman's badge, a scientific hypothesis and a doctoral degree. As early man came to accept the symbol as the reality, today we often mistake modern scientific theories for truth rather than abstract representations of truth and constructed mathematical or conceptual models of reality for reality itself. The sophisticated scientific theories, philosophical systems and theological doctrines that have influenced the development of knowledge and the evolution of society are all attempts to represent truths of existence in symbolic form accessible to human thought and communication.

3.2. Causality & Invention

Thoughts are a means of relating things with one another. The capacity to relate two or more things is a basic characteristic of thinking. But correlation is distinct from causation. Symbolic thinking attributes significance and power to things, but does not necessarily represent causal relationships. The capacity to relate cause with effect is a more advanced power of thinking, and one essential for the development of civilization.

One may wonder why it took so long for primitive human beings to learn how to imitate natural processes occurring right before their eyes. The invention of agriculture took place around 10,000 years ago and met an essential precondition for the evolution

of human civilizations. We can only speculate now regarding the mental processes that led to the invention of agriculture. The discovery of which plants, fruits, leaves, roots and flowers were edible and nutritious must have been a labor of many tens of millennia. The observation of where they grew and when they flowered and ripened must have taken even longer. But understanding these relationships was not sufficient to give rise to agriculture. Without language, these observations could not be communicated. Without written language, they could only be preserved by oral transmission from generation to generation.

It was also necessary for early man to closely observe the relationship between crops, soil types, rain, sunlight, temperature and the changing of the seasons. A long slow process of subconscious observation eventually must have led to the first conscious realization that human beings could replicate and even improve on the natural process. Instead of roaming the earth to find food, human communities learned how to imitate Nature. It fostered the development of sophisticated cognitive skills for planning, organization, specialization of function, and timely execution of complex sequences of activities. It led to the concepts of land as property and principles governing ownership. Agricultural surpluses spurred the development of trade and the advent of money, as a symbolic form of social power. The field of human productivity shifted from the land to the marketplace, from toiling on the soil to mutually beneficial interactions with other people. It spurred the rise of commercial centers, towns, cities, kingdoms, and overseas empires.

3.3. Early Civilizations

Archeologists associate the emergence of early civilizations with four important social developments: the invention of written language, the creation of cities with monumental architecture, specialization of work, and organized religion.[14] Organization is a characteristic power and action of mind. Mind organizes objects, ideas, beliefs, people, activities, events and countless other things. Civilization represents the outward organization of the life of the collective. It is made possible by the further development of a range of mental faculties and cognitive abilities.

The development of written language around 5000 years ago required a sophisticated capacity for precise definition, organization of thought and expression, and formulation of grammatical rules. The development of cities involved the orderly physical arrangement of structures, a division and categorization of activities, a hierarchical arrangement of authority and decision-making. Specialization of function required the capacity to break down complex activities into their parts, to arrange the sequence of steps and coordinate the relationship between multiple activities.

The development of religious symbolism and ritual long preceded the emergence of organized religion, which combines a mental construction of beliefs and ethical rules of conduct, a hierarchical organization of authority, social organization of the community and physical organization of events. The close and structured association between larger groups of people in cities was a catalyst for rapid advances in law, formal systems of weights and measures, trade, development of money, public administration, participative governance and education. These capacities in combination necessitated the systematic application of mental faculties at three levels—mental, social and physical.

3.4. Dividing Mind

Definition, categorization, organization, specialization, coordination and hierarchy are complex human endowments founded on the mind's capacity to differentiate aspects of reality, compare and contrast them, and express their relationships with one another in terms of space, time, characteristics, function, authority, action, and causality. These capacities derive from the power of mind for division and aggregation.

Mind is primarily and quintessentially an instrument of division. In its pursuit of knowledge, the characteristic action of mind is to divide reality into parts and deal with each of the parts as an independent whole. It distinguishes and categorizes these parts by comparison and contrast.[15] The earth is an undivided whole, but mind perceives it piecemeal, dividing it into geographic, geological and climatic regions, each with its own characteristics. All human beings share common characteristics, but they can be distinguished and sorted by size, sex, age, familial relationship, place of origin, skills, etc. The identification of differences is the basis for the mental faculty of definition, the delineation of characteristics, properties, qualities, categories, territories, social position, occupation, powers, privileges, varieties of behavior, personality traits, species of plants and animals, types of minerals, etc. There are innumerable ways in which the elements of any whole can be distinguished from one another. Therefore, there are an unlimited number of ways in which reality can be divided and subdivided. Thus, Wikipedia lists 27 types of snow and the Eskimos of Scandinavia have more than 200 words to describe different varieties of snow and ice.

Division is the origin of the mind's capacity for analytic thinking. The more it divides, the more it distinguishes, separates, compares and contrasts things with one another. It comes to consider each thing as a separate object of reality distinct from all others. Division also leads to abstraction of objects from their context. Thus we observe a ripe mango fruit as something separate and distinct from an unripened fruit, the inedible leaves, branches and trunk of the tree on which it grows, the soil in which the tree is planted, the sunlight and rain by which it is nourished, and the season in which it ripens. Similarly, mind divides us from one another and from the world around us. It separates the pursuit and dissemination of knowledge through science and education from the life of the community. It even divides our own inner psychological existence into thoughts, opinions, beliefs, sentiments, emotions, feelings, urges, desires, impulses and sensations. The mind's capacity for division is the origin of foundational concepts of modern science—the Cartesian divide between mind and body, the independence of the observer and object, and the distinction between objective and subjective forms of experience.

Mind also has a complementary capacity to aggregate the elements of reality it has divided in order to construct some conception of the greater whole of which they are the parts. Mind synthesizes the parts generated by analysis to create greater wholes. As the division of reality into parts is always based on a specific set of characteristics and differences, the aggregation of the elements to form a whole also depends on the characteristics used to reassemble them. Modern science has identified a diverse range of micronutrients known as vitamins, which are derived from a wide variety of very different sources and support the entire gamut of physiological functions, yet are grouped together to constitute a whole. In this case, the very small quantity required is the common factor between them that serves as the basis for combining otherwise very dissimilar substances. The whole can never be fully represented by an assembly of its parts, any more than the living human body can be represented by the sum of all the minerals, molecules, types of cells, anatomical organs, physiological functions and systems of which it is constituted. Thus, the whole is more than the sum of its parts, as Aristotle said. Analysis and synthesis, the capacity of the mind to divide and aggregate reality, lie at the root of all mental knowledge, the languages mind has evolved to formulate and express that knowledge, and the civilizations that have resulted from these developments.

3.5. Birth of Reason

What is described above is a simplistic rendering of the primordial stages of mental evolution in prehistoric times leading up to the creation of written language and the founding of civilizations. The capacity of the mind for acute physical observation, symbol and language formation, definition, categorization, correlation, organization and causation evolved gradually over very long periods of time in different places and grew through contact, exchange and imitation between early civilizations.

Thinking is primordial. The formulation of principles for valid reasoning was a later invention. The symbolic and intuitive knowledge of ancient India became in ancient Greece conceptual knowledge based on rational thinking and gave rise to the development of formal logic. They pondered the nature of definition and sought to identify the principles of effective reasoning. The Greeks sought to render reality into terms intelligible to the rational thinking mind. The Egyptians were concerned with the practical application of geometry. The Greeks transformed the practical tools of geometry developed in ancient Egypt into principles validated by formal proof based on logical reasoning. Greece lived in a world of ideas that were considered valuable in themselves, not merely for their practical utility.

Greece marked the transition from practically effective knowledge to ideative truth affirmed by rational mental processes. The combination and correlation of thoughts led to the development of complex abstract ideas and theories of knowledge. The birth of logic vastly augmented the mind's capacity for analysis by clarifying definitions and refining thought processes. The development of logic coincided with the conception that the universe is essentially a rational place that can be explained in rational terms.[16] The Greeks established science as the pursuit of knowledge of a rational universe knowable by observation and reason. Their science was wide and borderless, not confined to narrow conceptual boundaries or cut off from other forms of knowledge. It encompassed both natural science and philosophy. They developed democracy, mathematics, education, formalized the role of hypothesis and evidence in law, and based medicine on observation of symptoms and rational diagnosis.

The Hellenic period was remarkable for its development of rules for discernment by reason and logic and rules for communication through rhetoric and dialectic in quest of metaphysical and scientific truth. But it also applied analytic thinking to questions of justice, right and wrong, ethics and morality, which are at the core of organized religion and social thought. Nor did its rationalism prevent Plato, Aristotle and others from extolling the virtue of intuition in their mystical quest to realize transcendent spiritual truths.[17] The ancient Greeks also excelled in the application of the mind's aesthetic powers for the creation, appreciation and enjoyment in literature, architecture and sculpture. They invented a wide variety of expressive literary forms—historic, epic, philosophic, tragedy and comedy, pastoral and lyric, oratory and didactic. Reason, discrimination, judgment, imagination and intuition all contributed to the efflorescence of Hellenic civilization.

Hellenic civilization was extraordinary in one other way. It affirmed the value of individuality and individual uniqueness. Ancient Greeks never allowed strict rules of logic or mechanical laws of nature to infringe on the place of independent thinking, free will and creative imagination. They revered mathematics but would have scorned the indiscriminate application of statistical probability when applied to conscious human beings.

What is most impressive about Hellenic culture is its inclusiveness, sense of proportion, balance and harmony. Perhaps unique in history, the Greeks simultaneously pursued knowledge in all fields and by all means—in philosophy, metaphysics, polity, religion, the arts and applied science. They affirmed intuition and logic, aesthetic sensibility, mathematical precision and ethical conscience. They embraced the objective and subjective dimensions of reality. They applied the analytic powers of mind with great depth and precision, yet never lost sight of the larger reality which is eclipsed by the focus on minute particulars. They accomplished this by a remarkable tolerance and respect for diversity of perspective. While individual thinkers may have proclaimed with insistence the sole reality of the physical, their assertion was not permitted to overshadow or obscure contrary points of view. This sense of inclusiveness and proportion might well be the finest contribution of Hellenism to humanity. It appears all the more precious in the current age of exclusive concentration on the objective and the physical. Ancient Greece was able to aggregate an impressive range of perspectives, but it could not truly synthesize and integrate them to form a comprehensive conception of reality.

Rome inherited the Greek reverence for the powers of mind. But while in Greece, the principal field of application was mental knowledge and the creative arts, the mind of Rome was concentrated on social organization. Rome harnessed the powers of mind to organize the life of the polity, law, the military, economy, education, civil administration and civic life. It developed a written

body of law and a theory of jurisprudence. It organized education, establishing a widespread system of schools with a standardized curriculum. Greece gave birth to the modern mind. Rome gave birth to modern social institutions. Greece developed the intellectual and aesthetic faculties of mind to rare heights. Rome gave birth to the modern state founded on a culture of duty and discipline and based on development of the ethical faculty. The Greeks worshipped beauty. The Romans worshipped character.

4. Rise of Empirical Science

The evolution of mind in Europe was submerged for centuries during the Middle Ages by the collapse of the Roman Empire, the reversion to a feudal social structure, and the weight of church doctrine. Important developments during this period prepared the way for the explosive outburst of mentality that characterized the Renaissance, Reformation and Enlightenment.

4.1. Quantification of Reality

Quantification is an inherent power of the analytic faculty of mind that divides reality into smaller and smaller parts. The full development of the analytic mentality required the development of symbols, concepts and logical principles governing the use of numbers. The ancient Greeks gave emphasis to the geometric application of numbers for measurement, as in the fields of architectural engineering and astronomy. Indians made important advances with the development of the Hindu numerals and applications of trigonometry to astronomy at the end of the 5th century AD. With the perfection of the decimal system and solution to indeterminate equations and the addition of the zero symbol in the late 9th century, a decimal based system of positional notation was fully in place. The introduction of the Hindu numerals and algebra into Europe from Arabia gradually supplanted the Roman numerals. Precise quantification was extended to many fields of life. The use of letters in place of numbers in mathematics was introduced in the 13th century. The operational symbols in arithmetic were devised in the 14th. This was accompanied by a significant change in written notations. The order of subject, verb and object, the separation of individual letters into words, sentences, and paragraphs, the adoption of punctuation, chapter headings, headlines, cross references and alphabetization as an organizing principle were major advances. In combination, they facilitated the spread of literacy and the use of numbers. The spread of mechanical clocks from the late 13th century enhanced the consciousness of time. The development of musical notation combined symbols and mathematical concepts to denote both octave and tempo. The introduction of double entry resulting in the separation of assets and liabilities, debits and credits greatly facilitated the development of commerce and banking.

4.2. Return to Nature

While Greece focused on the application of mind to ideas and Rome focused on the organizing power of mind in society, the modern period began with intensive concentration of the powers of mind on the physical world. The power of the analytic mind turned its attention to the physical world of Nature. It gave rise to methods of inquiry that replaced the authority of Church doctrine with validation by physical observations.

A brief survey cannot do justice to the many stages through which modern science has developed or the complex array of civilizational advances that influenced that development. The founding of universities, spread of learning, and rediscovery of the Greek classical legacy gradually restored the preeminent authority of logical reasoning and empirical experience. It led to the development of inductive and systematic testing in the 12th century and the reemergence of mathematics, philosophy and metaphysics in the 13th century. A commercial revolution led to important innovations in agricultural production, manufacturing, entrepreneurship, trade, shipping, banking and insurance. This in turn gave rise to a bourgeoisie of unprecedented wealth and sense of independence, which spurred a radical reorganization of society with increasing freedom and independence from feudal and church authority. The revival of Platonic philosophy legitimized the pursuit of metaphysical truth through number, geometry and intuition, laying the intellectual groundwork for the emergence of rational, secular humanism and individualism in the 15th century.[18] The invention of the printing press facilitated that rapid reproduction and inexpensive dissemination of ideas. An efflorescence of originality in the arts coupled with the rise of individualism gave birth to the concept of genius, an idea unknown in the medieval world-view.[19] The Reformation brought with it a more tolerant and more secularly intellectual atmosphere for considering alternative viewpoints in the 16th century. The founding of learned societies and scientific journals in the 17th century established an 'invisible college' of independent thinkers to challenge orthodoxy, exchange new ideas and explore new discoveries and inventions. During the same period a new type of combinatorial mathematics developed based on analysis of gambling situations which ultimately gave rise to the inductive method of statistical probability. The spread of democratic ideas during the 18th century promoted freedom of thought and expression. The spread of education increased the population that could engage in and benefit from new ideas and scientific discoveries. All these factors gained far greater significance when the Industrial Revolution demonstrated the enormous power of science for generating wealth and military power during the 19th century. Although most of the early inventions of this period were developed by skilled mechanics rather than trained scientists, it soon became evident that a systematic study of scientific principles could vastly enhance the process of innovation. The marriage of science, technology and economy spurred the development of technical education in engineering, agriculture and medicine.

The remarkable achievements of science over the past four centuries are too vast and self-evident to be given adequate treatment in this paper. The focus here is on the profound impact the rise of empirical science and the scientific revolution has had on our conception of knowledge and the way we utilize the powers of mind to discover it. If inordinate attention seems to be placed on the limitations and unintended consequences of science as a pursuit of knowledge, it is with the hope that a greater understanding of these limitations and consequences will provide insight into the need and potential for evolving more effective instruments of knowledge and more successful forms of civilization in the 21st century.

4.3. Mind and the Scientific Method

Our primary concern is the relationship between these developments and our approach to understanding the world. Physical observation, measurement, analytic thinking and experimentation formed the foundations of modern science. Minutely detailed and careful observation of physical phenomena that could be independently verified by other observers was the starting point. Scientific instruments were developed to extend the reach of the senses and improve their accuracy. But the real power of modern science issued from a marriage of observation and measurement with analytic thinking.

The Copernican Revolution dramatized the limitations of sensory data as the basis for knowledge. From ancient times it had been known that sense impressions could distort reality. Copernicus applied logic and precise mathematics to refute the notion that all heavenly bodies move around the earth. Galileo confirmed this heretical view by using a telescope to observe four moons orbiting around Jupiter. Copernicus' discovery led to the formulation of a radically different world view that contradicted both the evidence of the senses and the prevalent conception. It ushered in what Kuhn calls a scientific revolution, based on a new conceptual system and a new method of knowing reality.[20]

Newton combined acute observation, precise measurement, reflective analytic thinking and mathematics to change the way science viewed the world for three centuries. His discovery of universal laws of nature and the invisible force of gravitation had profound impact on our conception of reality and knowledge. Newton applied new concepts and a new mathematics to arrive at a more precise understanding of the physical world. The concept of immutable laws of governing an orderly, machine-like universe became a conception in science. His work spurred advances in mathematics as a field of knowledge in its own right and as an instrument of knowledge applicable to all fields of existence. As a consequence, modern science has come to identify valid knowledge with mathematical proof and to search for knowledge in places where the light of mathematics can shine brightly.

4.4. Intellectual Impact & Cultural Consequences

The rise of modern science altered the course of global civilization, the evolution of the human mind and the development of our conception of knowledge in fundamental ways.

1. *Physicalism:* It led to the materialization of knowledge. The exclusive focus on knowledge of physical nature eventually led to the implicit premise or explicit belief that the physical is the sole plane of reality, a conclusion which Newton and other early scientists would have vigorously rejected. This premise is now pervasive even in the social sciences, where genetics and neuroscience seek to unveil the mechanisms governing psychology and even conscious mentality.

2. *Deterministic Mechanism:* The scientific revolution led to the conception of knowledge as a set of immutable, universal laws determining the functioning of a static, mechanical universe. Knowledge of reality became synonymous with certainty and predictability until challenged by the discoveries of quantum mechanics nearly three centuries later. Outside Physics this premise remains largely unchallenged. The Newtonian quest for immutable, universal laws of Nature was later extended to identify universal laws governing polity, economy and society. For the past two centuries economists have attempted to reduce human behavior and interaction to external factors and mechanistic processes governed by universal principles. The study of general principles has obscured the unique role of the individual in social development, innovation, discovery and creativity. The mechanical view of reality has led to the rejection of human free will as an appearance and neglect of individual uniqueness.

3. *Specialization:* Mind's capacity for division and analytic thinking inevitably led to a proliferation of separate disciplines, to specialization, and compartmentalization of knowledge with immense consequences. Over the last five centuries, the number of intellectual disciplines has multiplied from five to around 1000 disciplines and sub-disciplines. As the study of reality is divided up into smaller and smaller pieces, specialization has led to increasing fragmentation of knowledge. Viewing each field independently has generated precise knowledge of the parts, but obscured the complex interactions and relationships between elements that are essential for knowledge of the whole.

4. *Quantification of Knowledge:* It led also to the quantification of reality—the confusion of data and information with real knowledge and the misconception that mathematical models and statistical probability are true and accurate representations of the real world. Mathematics is an extremely powerful tool for the discovery and validation of knowledge. But increasingly it has come to be regarded as knowledge itself. In String Theory, mathematical consistency has become a substitute for measurable, verifiable evidence. The awarding of two Nobel Prizes in economics for development of computer algorithms that model the functioning of financial markets is only an extreme example of a widely prevalent phenomenon. Its consequences during the financial crises of 1998 and 2008 underline the extreme danger of mistaking models for reality and mathematical formulas for knowledge.

5. *Measurement of Randomness and Uncertainty:* An unintended consequence of the Scientific Revolution has been to redefine the notion of chance. The conception of the universe as a giant mechanism subject to universal laws of causation made it possible to also postulate its very opposite, a complete absence of causality, pure randomness.[21] The development of probability theory originally aimed at obtaining knowledge about complex causal processes, but later was applied to situations assumed to be characterized by a total absence of causality. The merger of probability and statistics in the early 20th century resulted in the new hybrid field of mathematical statistics. Under the influence of positivism the philosophical dimension of causality was dropped and probability came to be viewed purely in mathematical terms as an expression of randomness.[22] The application of *a posteriori* induction to ascertain the likelihood of future events dramatically broadened the application of mathematics to the

human sciences, with profound consequences.[23] The concepts of uncertainty and randomness were inadvertently elevated from philosophical questions to the status of objective scientific fact.

6. *Dominance of the Objective:* Modern science commenced with an exclusive focus on the study of observable external phenomena in the material world which lent themselves to measurement, verification and experimentation. This led to the rise of the philosophy of positivism, founded on the premise that information derived from sensory experience, interpreted through reason and logic, forms the exclusive basis for all authoritative knowledge. Only knowledge that can be independently verified can be considered authentic. Thus, knowledge of the objective world and knowledge acquired by objective methods alone is valid. The study of subjective phenomena and subjective forms of evidence became inadmissible and invalid. Introspective and intuitive knowledge were rejected. In the 20th century logical positivism rejected metaphysics as pure speculation and attempted to reduce statements and propositions to pure logic.

The contributions of modern science to the march of civilization are immeasurable. Even its tendency toward exclusive concentration on physicality, the objective world, the measurable, quantitative, and universal has had salutary effects of great value. Materialism has wiped away much that was merely superstitious or speculative. Its irreverent questioning of acknowledged truths has unleashed an insatiable curiosity and spirit of adventure. Its ruthless rejection of unfounded opinion and prejudice has helped discipline the thinking mind to challenge opinions, shed preferences and prejudices, question conventional beliefs and challenge established authority. Even its atheism has helped cleanse religion of pious posturing and vacuous moralizing. It has served as a basis for the democratization of our lives as well as our minds, at least within the boundaries of the world as science perceives and understands them.

Each of these characteristics has contributed positively to the advance of scientific knowledge and is partly responsible for its collective achievements over the past five centuries. At the same time, each of them has imposed arbitrary limits on the development of knowledge. After reigning victorious for four centuries, today we see the weaknesses and insufficiencies of modern science rising to the surface, staring at us with its unvarnished flaws and glaring inadequacies. Byers used the term 'blind spots' for intrinsic limitations to what can be known through science.[24] It behooves us to generously recognize its enormous contribution, and yet equally to acknowledge and inquire into its errors, omissions, blind spots, prejudices, pompous presumptions, superstitions and intolerances—the very characteristics against which it first arose in rebellion and has since fought for centuries to eliminate. An impartial consideration of their role will help us understand both the strengths and weaknesses of science today and reveal opportunities for the further advance of both knowledge and civilization.

4.5. Objectivity & Subjectivity

The initial concentration of modern science on physical nature was justified as a logical choice and practical necessity. The rise of positivism converted practical necessity into philosophical dogma with profound implications for the development of science and the further evolution of mind. The transition was abetted by confusion regarding the ambiguity of the terms objectivity and subjectivity, each of which has a double meaning. The study of physical nature is the study of inanimate objects and subconscious life forms which can only be observed objectively ("observe as object") in the external environment, since we have no access to their subjective intentions or self-experience. Descartes' body-mind dualism encouraged the idea of the scientist as an objective ("impartial") witness standing outside of nature, rather than as an involved participant in the world he observes. Gradually, the notion of objectivity as the study of external objects without impartiality merged with the very different notion of objectivity as the absence of 'distorting personal preferences' of the subject and came to be regarded as one and the same thing. This led eventually to the philosophical premise that reality consists solely of objects that can be studied objectively and by extension that all subjective phenomena are secondary results of objective causes.

The word subjectivity also has two meanings which have gradually become conjoined and confused with one another. Subjectivity ("experience as subject") is the psychological field of conscious human experience that is not directly accessible to external observation. Only its behavioral expressions can be observed by others. But it is also used to connate subjective ("personally biased and preferential") factors contributed by the observer, such as preconceived notions and prejudices, the legacy of traditional beliefs and superstitions prevalent at the time.[25] In its quest for impartial knowledge of physical objects in the world around, emphasis was naturally placed on eliminating this distorting influence. So the idea of subjectivity as the psychological experience of a conscious individual came to be regarded as an unscientific and invalid form of evidence and to some extent an invalid form of experience. As in the anecdote of the man who lost his keys on a dark street and searched for them down the block under a street light where there was better light, science sought to discover ultimate knowledge by the exclusive study of physical factors that could be observed by the physical senses and measured by material instruments. In the process the entire subjective dimension of reality, the dimension which distinguishes human beings from all other species, was subordinated to the objective dimension observable by the senses. Eventually it resulted in philosophical and scientific efforts to reduce all non-physical phenomena solely to physical causes.

The course of science exerted a subtle influence on the development of mental faculties and concepts of truth, knowledge and logic. It displaced the Greek conception of truth as that which could be known in the form of pure ideas accessible to logical reasoning, but not necessarily to physical observation or measurement. Rationality itself came to be narrowly associated only with that which can be perceived and verified physically. The old adage that I will believe it when I see it acquired the status of scientific dogma, even when applied to aspects of reality beyond the reach of the senses. This phenomenon might be termed the materialization of knowledge.

4.6. Fragmentation of Reality

Divide and subdivide reality ever so much and we still arrive at some smaller portion of reality that eludes our grasp. The infinitesimal is infinite. The dominant role of the analytic intellect in modern science resulted in the dissection of knowledge into smaller and smaller fragments resulting in the proliferation of specialized fields of study. Analysis is an extremely powerful instrument. It harnesses the dividing power of mind to separate reality into smaller and smaller parts. By so doing, we acquire more precise, detailed knowledge of the part and are enticed to drill down to ever deeper levels of minuteness. As its focus narrows to laser-like precision, the surrounding fields and interconnected aspects of reality grow proportionately out of focus and obscure. The more we know the part, the less we know about the integrality of the whole.

Physical science has compensated for this divisive tendency by aggregating knowledge from different specialized fields to form a remarkably cohesive and coherent conception of the physical universe. It has successfully incorporated the fundamental principles of physics into chemistry and the principles of both into astronomy, geology, the material sciences, climatology, oceanography, soil science and innumerable other disciplines. While the same fundamental principles are consistently applied, the interactions between subsidiary fields founded on these principles have been less effectively related and integrated. Partly, this is due to the complexity arising from these multiple interactions, but also partly because research and theorization have largely proceeded in a compartmentalized manner. Raging controversies regarding climate change are partly attributable to the fact that for so long the complex array of phenomena that influence climate have been studied piecemeal, independently from one another.

The consequences of compartmentalization and fragmentation become more evident when we look at the life sciences. Here the effort to overcome compartmental barriers is far less advanced. Interdisciplinary and cross disciplinary research have become more common, but the fundamental principles applied in different fields remain largely autonomous. For decades, evolutionary biology remained preoccupied with the exclusive role of random mutation in the evolution of species, ignoring important biological and environmental factors that impact on the chemistry and biology of genetic materials.

In medicine, specialization has led to remarkable progress in our understanding of specific pathologies, but it has taught us relatively little about the overall concept of health. Moreover, the piecemeal treatment of specific illnesses often has consequences quite detrimental to the overall health of the patient. In allopathic medicine health is conceived primarily in negative terms as the absence of disease; whereas in traditional systems of medicine such as Ayurveda, developed by reliance on more synthetic and integrative mental processes, health is conceived in positive terms as the property of a balanced and harmonious living organism. This becomes even more evident when we take into account psycho-somatic phenomena. Research on the 'placebo effect' dramatically demonstrates the impact of the patient's attitude and expectations on treatment outcomes and general health. Indeed, recent findings indicate that the placebo effect is increasing over time. This and other phenomena directly connecting physiological and psychological processes testify to the need for a much more synthetic conception and approach.

5. Naturalization of the Social Sciences

The six characteristics of empirical science discussed above have each had profound impact on the development of mind, knowledge and modern civilization. Re-examining the implicit and explicit premises underlying modern science is vitally needed to further the advance of knowledge in all fields. But the limitations of the prevailing approach are most apparent in precisely the fields of knowledge closely associated with the challenges humanity confronts in coping with rapid and radical global social, economic, political, intellectual, technological and cultural evolution. Therefore, it is especially necessary to consider whether the application of the analytic methods of the natural sciences to the social sciences is itself one of the root causes of the current problems confronting humanity today.

A comparison of the natural and social sciences needs to take into account the significant differences between these two bodies of knowledge. The most obvious is the fact that systematic study of physical and biological phenomena began several centuries before the systematic application of the scientific method to the study of society. By comparison the social sciences are still in a very early stage of development. Furthermore, there is an enormous difference in the intricacy and complexity of the phenomena being studied in the two realms. Living organisms are far more complex than inanimate material objects. In addition to possessing all the attributes of material things, they also superimpose on their physical base structural and functional characteristics and environmental interactions not found in inorganic forms. This adds enormously to the complexity of living things.

The same is even more true of the phenomena studied by the human sciences. To the complexity of physics, chemistry, biology, genetics and earth sciences, is added the complexity of conscious, self-aware purposeful human beings living in complex social and cultural environments, interacting with myriad social institutions and organized activities, utilizing a vast array of tools and instruments, and influenced by the cumulative knowledge and experience of countless generations of humanity. Moreover, the level of individuation, complexity and uniqueness observed in human beings is far greater than that found in other life forms. The behavior of every electron, every atom of hydrogen and every red blood cell may be identical, but the behavior of every individual human being is characterized by a very large degree of variation and uniqueness. The range of factors influencing behavior and outcomes defies numeration. Physical and biological factors apply, but social, cultural and psychological factors play a determinative role. Individuality may safely be ignored in the study of physical and biological phenomena, but it is central to the knowledge of conscious human beings.

5.1. Fragmentation in the Social Sciences

The problem of compartmentalization of knowledge in the social sciences becomes evident when we consider that each discipline has developed its own set of fundamental principles and applies them relatively independently from the rest. Different concepts and hypotheses regarding human behavior are routinely adopted by political scientists, economists, sociologists, anthropologists, lawyers, and management scientists, yet all with application to the same subject—individuals and groups of individual human beings. No universally accepted principles are uniformly applied across fields.

The consequences of this fragmentation are apparent in the problems we confront related to environmental degradation, unemployment, political instability, social alienation, crime, drugs, and psychological disorders. For two centuries Economic theory developed without giving serious consideration to the impact of human economic behavior on the physical environment. Similarly, the development and application of technologies for economic purposes have been done without regard for their impact on employment, social stability, human welfare and well-being. Many economic theorists ignore the central role of political regulation in the successful operation of free and competitive markets. Legal theory has become increasingly divorced from political principles, social aspirations and human rights. The humanitarian rights of humanity are rejected on the basis of legal principles that recognize only the rights of sovereign nations, not of their citizens.

The same fragmentation of knowledge occurs within disciplines supporting an increasing divorce between different aspects of our social existence. Backed by fragmented theoretical conceptions, financial markets have become divorced from the real economy and the economic welfare of people which they were originally intended to support. A similar fragmentation has led to the treatment of a wide range of psychological problems as if they are simply physical in origin.

The Cartesian divide also isolates and insulates social science from society and the social consequences of its theories. Theorists assume no responsibility for the failures arising from application of their flawed conceptions, as exemplified by the global crisis of 2008. Scientists in leading universities refuse to acknowledge or apply the findings of educational researchers in the same institution about the most effective pedagogy to promote learning. Medical doctors are licensed without receiving any training in managing patient and family relations. The list of gaps and short-circuits is endless.

5.2. Legitimacy of the Subjective

The phenomenal success of the natural sciences spurred efforts by early social scientists to imitate and replicate the same approach. The discovery of immutable universal laws governing the physical universe led to a search for similar principles applicable to society. The extension of the concept of law to conscious human behavior, individual and social, has been the source of endless confusion and error. The governance of political systems and the functioning of our economies are not determined by natural law. They are the result of conscious choices made by individuals and groups in the past, which have undergone a continuous process of evolution over the centuries and are always subject to modification by conscious choice. The resistance posed to social and psychological change by established habits, beliefs, self-interests and inertia may indeed be formidable, but no social arrangement is unchanging or inevitable.

In the field of Economics, the enunciation of principles and the construction of mathematical models similar to those in Physics have fostered a basic misconception regarding the factors that govern economic systems and the scope for altering their outcomes. For nearly two centuries the Newtonian concept of equilibrium in a static universe that dissipates energy and tends toward the lowest possible energy state prevailed almost unchallenged in Economics. The theory of perfect, instantaneous equilibrium is inapplicable to social systems that function far from equilibrium, adjust gradually, organize energy and continuously evolve higher levels of orderliness.[26] The extension of the principle of scientific laws has fostered passivity and resignation before social injustices, political oppression, economic inequality, and other social ills. The vastly disproportionate distribution of the world's wealth, the displacement of human beings by machines, the subordination of women, the political influence of the rich, and the social exclusion of minorities are the results of human choice, not natural law.

Similarly, the Darwinian concept of the evolution of subconscious biological forms narrowly viewed as competition and survival of the fittest was inaptly applied and later rejected with respect to conscious social systems. Society evolves by processes that are conscious and subjective. Aspiration, curiosity, observation, thinking, creativity and imagination are more fundamental than external forces in human social evolution. Competition takes place within a wider and more fundamental framework of cooperation. As this narrative affirms, human evolution is a complex conscious process involving continuous interaction among the objective and subjective dimensions, physical facts and mental conceptions, natural forces and human aspirations, creative individuals and social groups. Analogies between the natural and human world may provide useful insights into similarities and parallels between the two domains. But the automatic extension of physical principles to conscious living beings conceals more than it reveals, obscures rich complexity by overly simplistic assumptions, and reduces the profound creative complexity of human existence to rudimentary mechanical models and quantitative equations.

The consequences of the conflation of objectivity with reality and subjectivity with unreality as discussed earlier are most evident in the study of humanity's conscious social and psychological existence. It is here that the confusion regarding impartiality and reality has imposed the most serious obstacles to the progress of knowledge. The identification of knowledge with objective fact has erected a serious barrier to the progress of knowledge. The sciences of society and psychology are concerned with the actions of conscious human beings. Those actions include not only the physical movements of our bodies, but also our mental actions of observation, thought, will, imagination and creativity. They also encompass our vital actions of perceiving, feeling, emoting,

aspiring, fearing, desiring, loving, enjoying, playing, and so forth. The effort to discount, dismiss, or delegitimize our subjective experience is to reject all that is most truly human about us, simply because it does not lend itself to observation and measurement in physical terms. The effort to compress, reduce or reinterpret all subjective experience solely in terms of neurophysiology is akin to looking for lost keys under the street light, because that is the only place our eyes can see.

It seems reasonable that the physical scientist studying matter assumes the position of an observer mind witnessing an independent physical reality. Yet the same premise does not equally apply to a psychologist examining a subject's conscious and unconscious mind. Self-experience is the most vividly real and tangible experience of which human beings are capable. Indeed, we can never experience anything else so directly and intensely. When we impartially examine the supporting evidence, we realize that the reduction of all subjective experience arises from the initial premise of physical science rather than from either rational or evidential justification. The fact that there are neurophysiological correlates to our conscious experience no more proves that our thoughts and feelings are the result of neurophysiological phenomena than the fact that adjusting the dials on a television proves that the program being broadcast originates from the TV.

Nevertheless, the pursuit of extreme hypotheses such as this one and the presumption that human intelligence and machine intelligence are the same may serve an evolutionary purpose. Indeed, it can help us understand the mental and social processes by which both mind and civilization have advanced up to the present stage. Undoubtedly there are correlations between our mental and physiological processes. An impartial observation of both the similarities and differences between them may generate valuable insights. But this requires that we remain conscious of the hypothesis we are testing.

The problem of objectivity goes still deeper. In regarding reason as an impartial judge and witness of reality, we overlook the implicit biases that colors all rational thought. Reason has a pronounced tendency to concentrate on facts and ideas consistent with its premises and to ignore or differently interpret those that contradict it. Science is itself a subjective discipline for generating knowledge governed and framed by philosophical conceptions that are themselves inherently 'unscientific' because they cannot be validated by the scientific method. The effort to exclude philosophy from science suppresses open discussion, but can never eliminate its subjectivity. In denying the validity of subjective forms of knowledge, science invalidates itself.

5.3. Quantifying Humanness

The application of statistics to social problems has brought to the front inherent problems with the quantification of human experience. Nassim Taleb argues in *The Black Swan* that for over a century social scientists "have been operating under the false belief that their tools could measure uncertainty."[27] The enormous power of quantitative methods has progressively obscured the important contribution of qualitative components of reality and individual differences in the social sciences. Taleb seeks to challenge a blind or misguided sense of confidence in the reliability of political and economic decisions based on statistics. He concludes that the problem lies in the structure of our minds.[28] On the other hand, Weisberg argues that precious qualitative information relating to individual differences is being consciously suppressed or neglected in clinical fields such as medicine and psychology by what he terms 'willful ignorance'.[29] Both these viewpoints reinforce the need to reexamine fundamental philosophical issues with respect to the application of quantitative methods to the social sciences.

The point here is not to criticize either science or social science. It is rather to emphasize the inherent limitations and untoward consequences that arise from a partial, one-sided and unbalanced development and application of our mental faculties. The knowledge we need is very unlikely to be discovered by objective analytic methods, quantitative measurements or experimental neuroscience. It lies in our conscious experience and can be most directly accessed by reflecting on our own mode of functioning as scientists, rather than hunting for answers through mountains of clinical experiments. Mind has been the instrument of all humanity's achievements and it lies at the root of the problems confronting civilization today. No other field of scientific inquiry has so much to offer.

6. Synthesis

Long before the development of logic, the ancients discovered the profound truth that reality is one and indivisible. What mind infinitely divides for the purpose of analysis remains at all times a unified, integrated whole. Mind's capacity for analysis and its capacity for synthesis are in constant tension. The more we divide reality for the purpose of understanding its component parts, the more we lose sight of the interconnections, relationships and interdependencies that reflect its underlying unity. Division and aggregation present complementary perspectives of reality. The microscope and the telescope are instruments fashioned by these compensatory needs to zero in on a specific target and zoom out to see the big picture.

The inherent limitations and inadequacy of the knowledge generated by extreme specialization, compartmentalization and fragmentation became increasingly apparent in the 20th century and inevitably gave rise to efforts to reunite that which had been torn asunder into tiny fragments. Compartmentalized universities introduced interdisciplinary, cross-disciplinary and multi-disciplinary studies and research, which sought to bring a variety of different perspectives to bear on problematic issues. But the inherent limitations of these efforts soon became evident. Each brought to the problem a different set of concepts, theories and evidential data to talk about the same problem, without any shared conceptual framework indicating the relationship between these disparate perspectives, their interdependencies or the unifying factors underlying their different expressions.

6.1. Systems Thinking

The limitations of aggregating multiple sets of data based on different theoretical frameworks gave rise to efforts to conceptualize

the relationships between all the parts by viewing the whole as a complex interconnected system. Cybernetics evolved as the study of control systems in the early 20th century in the fields of electric network theory, mechanical engineering, logic modeling, evolutionary biology and neuroscience. Its insights contributed to the theory of complex systems. It stimulated transdisciplinary research in information theory, artificial intelligence, robotics, medical science, economic systems, biology, cognitive science, management, sociology, and the earth sciences. The systematic application of mind's capacity for synthesis led to practical applications of immense importance in computer science and communications. A similar approach has been adopted to build systemic theories and models of global financial markets and the global economy, as well as to comprehend the complex array of forces that govern the climate of the earth and on the impact of human behavior on the planet.

Systems theory has helped compensate for the extreme fragmentation of knowledge resulting from specialization. It has restored a vision of the totality of existence within specific fields and with relation to specific problems. The significance of this change in thinking is most dramatically reflected in the development of the Internet and World Wide Web over the past few decades, giving rise to the world's first truly global social system. Conversely, the practical development of cyberspace has provided a tangible example, symbol and metaphor for systemic thinking and has been a catalyst for the development of more comprehensive, inclusive thinking in all walks of life.

But the development of core complex systems theory extends beyond the mind's capacity for aggregation and synthesis. At a more fundamental level it seeks to identify universal principles that underlie and govern the behavior of complex adaptive systems in a very wide range of applications, such as network effects, emergence, self-organization, and self-reproduction (autopoiesis). It represents a serious effort to move from the aggregation of specialized knowledge through multi-disciplinarity to the search for unifying trans-disciplinary principles.

6.2. Barriers to Systems Thinking

In spite of these momentous developments, the advance of knowledge remains encumbered by several other characteristics of the Scientific Revolution which have yet to be seriously challenged. The first and most obvious of these is the mechanization of reality. The perception and conception of reality in mechanical terms still dominate scientific thinking, even with regard to living beings and conscious individuals. The idea of a simple clockwork universe has given place to more complex network models, but the models remain very largely mechanical and mechanistic. Science still tends to perceive all phenomena, even life, consciousness and society, in physical terms, and to reduce them to theirs lowest identifiable physical denominators. Our physical conceptions have become more complex and sophisticated, but the underlying materialistic mechanistic thinking remains. Computerized modeling of financial markets and economic systems remains the primary instrument for both theorizing and policy-making. Neurological models of human behavior that have proven effective for the tracing of sensory pathways and muscular responses seek to reduce all conscious human experience to chemical and electrical events, resulting in a dramatic increase in use of drugs for the treatment of conditions with obvious psychological and social origins, such as attention deficit disorder.

The second limitation of the current approach is the persistent emphasis on the universal aspects of behavior. Science is the quest for knowledge. It began with the study of fields in which the type predominates and individual variation is of little or no significance. The physical elements readily lend themselves into categorization on the Periodic Table. The known subatomic particles come in a few discrete varieties. The laws of motion and thermodynamics apply uniformly within broad boundaries as do the principles of relativity and quantum mechanics. Plants and animals lend themselves to classification in terms of phylum, class, order, family, genus, and species. The tendency to view reality in terms of categories and types has been extraordinarily effective in advancing knowledge in the natural sciences. It is inevitable that the same approach would be extended to the study of individual and collective human behavior. The classification of similarities and differences has led to important advances in the social sciences, but it has also imposed serious barriers to knowledge of human beings. Comparison of types inevitably results in suppression of individual differences. Uniformity of type is characteristic of the inanimate and subconscious ranges of reality, but the most significant attributes of human consciousness are individuality, innovation, creativity and uniqueness. The human sciences remain grounded in the bias of natural science for viewing reality in terms of similarities and differences and ignoring the single most momentous development in the history of the universe—the evolution of conscious individuality. This bias is programmed into the way we use our minds and imprinted in our very conception of reason and logical thinking. Our very notions of rationality and logic, the rules by which our minds seek knowledge, are based on implicit biases and limitations that retard the development of knowledge.

The third major limitation of modern systems thinking inherited from natural science is the suppression of the subjective dimension of reality. Indeed, most complex systems are an attempt to define and represent all subjective experience in physical terms and to reduce conscious experience to automatic subconscious processes. The collapse of the subjective into the objective dimension is dramatically illustrated by prevailing economic models of society. The assumption that human beings make rational decisions is only another way of saying that individual decision-making can be modelled in mechanistic terms without recourse to consciousness, just the way we say that plants lean toward the sun and their roots reach out for water. The obvious fallacy in this assumption has compelled economists to introduce terms such as irrational exuberance to explain the extreme fluctuations in the behavior of markets under extraordinary circumstances, while leaving intact the underlying premise for normal applications. Economic behavior is characterized by myriad subjective factors—aspirations, attitudes, preferences, the search for status, fear, insecurity, ambition, interest, curiosity, attraction, ideas, misconceptions, superstitions, prejudices, opinions, beliefs, ideals, values,—that vary markedly from person to person, moment to moment. The consequences of the near exclusive emphasis of economics and other social sciences on the objective dimension of human behavior are apparent in the inability to comprehend and manage the increasingly complex

social world in which we live. The effort to reduce complexity so we can manage it can only be successful in the measure our conception embraces the full scope of that reality.

Fourth and as a consequence of the other three, the efficacy of systems thinking is impacted by inherent limitations in the concept of randomness and the measurement of uncertainty as applied to human systems. As Byers has argued, randomness and uncertainty are ambiguous concepts. The appearance of randomness may result from the real absence of causation or from a lack of information, effective measurement and valid knowledge. Black swans may surprise and overwhelm us because a phenomenon is truly random or simply because our concepts, models and measures are grossly inadequate to represent what is really going on. They are likely to become increasingly prevalent, so long as our study of human behavior neglects subjective factors, individual uniqueness and conscious human choice.

7. Integration and Unification

All knowledge seeks unity. The greatest discoveries in natural science have been those that led to the unification of phenomena that had hitherto appeared to be unrelated to one another. Thus, Newton unified inertia and motion. Maxwell unified electricity and magnetism. Einstein unified space and time, gravity and acceleration. WAAS Fellow Abdus Salam unified the electromagnetic and weak nuclear forces.[30]

The capacity to identify relationships between apparently unconnected or contradictory phenomena is one of the defining characteristics of genius. The quest for unification in Physics has spurred efforts to formulate a Grand Unifying Theory reconciling the physical macrocosm and microcosm. Should it ever succeed based on the present premises, it could only apply to the plane of inanimate matter and energy. A Grand Unifying Theory of Life or of Mind or an integrated theory encompassing all three would remain elusive.

A mere aggregation of variables to encompass the totality of phenomena is not sufficient to achieve true integration and unification. Synthesis can combine and relate the parts, but it cannot arrive at true integration. Although the word is widely used in a more limited sense as synonym for totality, comprehensiveness, holism and interdependence, true integration that is the basis for unification is something more fundamental. It may be best described in the words of the Upanishads as *all is in each, each is in all, all is in all.* Integration is a state in which each element in a totality is not only related to the totality but also to every other individual element in the totality.

The struggle of climate scientists to construct accurate and effective theories and models of climate change is compounded by the fact that the entire earth with its myriad zones, geographic and geological characteristics is in constant interaction with the life forms that inhabit it and the conscious and subconscious activities they carry out. Climate is impacted not only by physical factors, but also by the biological functioning of living things and the conscious and subconscious actions of human beings. Our capacity for analysis and synthesis is poorly suited to manage complexity of this sort.

The remarkable integrality of the human body is an excellent example and analogy. Medical science has created an abstract conceptual framework to represent the functioning of the body. It is divided into anatomical structures and physiological functions. The structures include cells, tissues, organs and systems. The functions include respiration, digestion, circulation, reproduction, and so forth. But both of these classifications are themselves abstractions. There really is no such system as the circulatory system distinct and independent of the skeletal, muscular, nervous, lymphatic and other cells, tissues, organs and systems. Each cell, tissue and organ forms an integral component of the overall body. But the functioning of each type is also integrated with the functioning of other types. Thus, a prick of the surface tissue of the finger may evoke a response from the skin, capillaries, blood cells, heart, brain, glands, circulatory, nervous and lymphatic systems. Moreover, as the Placebo Effect and other well-documented neurological, psychological and sociological phenomena amply testify, the body's physiological functioning is also seamlessly integrated with a host of other factors—nutritional intake, physical environment, type and amount of physical activity, the endless flow of sensations, impulses and emotion occurring consciously and subconsciously, mental conceptions, opinions, attitudes, beliefs and aspirations of each individual, as well as the ever-changing physical, emotional and mental interaction between the individual and the physical, social, and psychological context in which it is situated. The limitations in prevailing conceptual models of reality severely hamper efforts to pass beyond an aggregation of physical parts and functions to a truly comprehensive integral conception of human health.

The conclusion that present knowledge is inadequate to guide the further evolution of human civilization is not an indictment of the vast body of specialized knowledge of society generated by science up to now. It is rather a realization that more of the same will not suffice. Relativity Theory did not invalidate the principles of Newtonian Physics. Rather it placed them in a wider context, in which their limits became evident. Today, there is a need to venture beyond the limits of the present conceptual system in search of one that is more inclusive and effective in reconciling our knowledge of the world with the persistent failures and recurring problems that stand in contradiction. The first step in the evolution of a new conceptual system is to acknowledge and embrace these contradictions and willingly reexamine the premises which constitute the foundations of the present conceptual system.[31]

7.1. Integration in the Social Sciences

The need for transcending the limits of both analytic and synthetic thinking is most apparent in the social sciences where compartmentalized, fragmented knowledge persists as the dominant pursuit and each field is founded on a discipline-specific set of principles with little relevance beyond the narrow borders of specialized applications. This approach has generated a condition resembling the psychological syndrome of multiple disconnected personalities known as dissociative identity disorder. In both

instances it is symptomatic of deeper disorder. In an effort to arrive at rational, scientifically valid knowledge, we have fallen prey to the natural tendency of the thinking mind to separate itself from the objects of study in a static universe and regard them from a detached perspective objectively and impersonally. In doing so, our sciences of living human beings have become mechanical, materialistic, value-free and lifeless. They lack the vibrancy characteristic of living things. They lack the depth and insight needed to plumb the rich complexity of the individual psyche and collective soul. "Classical, deterministic science is a science of stasis. It misses the essence of life".[32]

This realization has been the driving force behind the efforts of the World Academy of Art & Science and World University Consortium in partnership with other organizations to advocate the need for a new paradigm in human development, a human-centered economic theory, and a transdisciplinary science of society. Our work has identified critical respects in which the new conceptual framework needs to transcend the limits of the present one. The new paradigm should be value-based rather than value-free. It should be transdisciplinary rather than discipline specific or merely multi-disciplinary, which means it should seek to discover the underlying principles governing human behavior in all fields of social existence. It should embrace and reunite the objective and subjective dimensions of reality, recognizing the central role of human consciousness and human aspiration in human affairs. It should be founded on the creative process governing the interaction between the individual and the collective. It should rise beyond the mechanistic, materialistic models of natural science to establish knowledge based on the dynamic living process by which human beings release their energies, consciously and purposefully direct them, channel those energies through formal organizational and informal institutional structures and systems, and express them through skilled action to accomplish results. And as a foundation and central pillar of this work, it should strive to advance our understanding of the human mind and thought processes, the sources and obstacles to creativity and their relationship to the evolution of civilization.[33]

Preliminary work has been done by members of the Academy on many elements of a new approach, but the real purpose of the project is to influence the general direction and course of our collective intellectual progress. Decades ago Former WAAS President Harold Lasswell made a profound contribution to the study of law by liberating it from the narrow confines of legislatures and judiciaries and viewing it in the context of evolving social and political processes and the affirmation of values by individuals and institutions in society.[34] In a remarkable contribution to rethinking economics, Orio Giarini strove to break down the arbitrary conceptual barriers imprisoning contemporary economic theory. He expanded economics to encompass the non-monetarized sector, introduced the concept of negative value to account for economically detrimental activities, emphasized that in a modern service economy value must take into account the entire utilization time from conception through final disposal, replaced the classical notion of equilibrium with one of continuous evolution, and affirmed the principle of uncertainty as central to all economic activity.[35] Building on his seminal contributions, WAAS is engaged with other institutions and scholars in a collaborative effort to frame new economic theory.[36,*] A fuller exploration of these findings lies beyond the scope of this paper, but it may be helpful to briefly examine a few of its central tenets.

7.2. Value-based Science

Popper warned against the tendency of the social sciences toward 'misguided naturalism'.[37] The effort to free the study of the natural world from religious doctrine rejected the imposition of human values on the natural world. The role of the natural scientist is to observe dispassionately and reflect rationally. Freedom from prejudice is essential for discovering knowledge. With respect to physical nature, this implies not imposing human values on the behavior of lower life forms. We cannot accuse the lion of evil because it instinctively hunts other species for food. But the social sciences involve the study of conscious human beings living together. The discovery of universal values governing conscious human evolution is the social equivalent of the universal laws governing physical evolution. The purpose of social science is not merely to impartially understand but also to consciously intervene to enhance the effectiveness of social systems to realize the aspirations and values of humanity. It must necessarily be value-explicit rather than value-free.

Values are not merely prejudicial judgments. They are a form of knowledge and a powerful determinant of human evolution. To strip our study of society of all values is akin to viewing the material world as random, chaotic, directionless meanderings of chance stripped of all insight into the forces influencing it. Values are the governing principles of human evolution, just as natural laws are the governing principles in physical nature. Universal values such as freedom, equality, peace, security, tolerance, trust, integrity, goodwill, organization, cooperation, collaboration, fraternity, self-giving, harmony and truthfulness represent the quintessence of knowledge and wisdom humanity has derived from millennia of experience. Values are knowledge of the process of human accomplishment and evolution. They are central to the practice of science as they are to every other field of civilized human activity.

7.3. Principles of Society

As already mentioned, the development of economic science has been strongly influenced by the success of the quantitative physical sciences, most especially Physics. It has taken the form of a quest for universal laws or principles of economy and mechanistic, quantitative models to represent the workings of economic systems. The economy we have today is the result of choices made in the past, of a long evolutionary process founded on ideas, values, beliefs, and social institutions established for the benefit of specific sections of the population and preserved by force of social influence. If it is not able to equitably meet the needs of all human beings, we have the power to change it.

* For information on the partners and working papers, see www.neweconomictheory.org

The rejection of immutable laws of economy does not mean that there are no principles governing the development of economy and society. But it does suggest that these principles are more fundamental than what commonly passes for economic principle, as the principles governing chemical interactions are founded on a more fundamental set of physical principles. Economy is a subset of society. An understanding of the principles governing the development and operation of economy needs to be founded on principles applicable to the development and evolution of the wider society of which economy is a part.

The success of organizational theory and systems theory in identifying principles applicable to a wider range of human and non-human activities marks a first step toward development of truly transdisciplinary social science. Organization is a unifying principle found at all levels of existence—the structure of physical matter, the dynamic systems of life, and the conscious organization of ideas, activities and things characteristic of mind. Energy is another unifying principle—the physical energy of material systems, the vitality and social energy characteristic of living systems, and the conscious mental energy expressing as curiosity, imagination and creativity in mind. Conscious awareness, aspiration, values, evolution, self-multiplication, authority, hierarchy, networks and conceptual frameworks are fundamental principles common to all human activity. Transdisciplinary science founded on principles such as these would mark a significant advance toward a new conceptual system for the social sciences. It should shift the perspective of society from inanimate, mechanistic organization to conscious living organism, from a perspective that focuses exclusively on objective, superficial processes to one that encompasses both the subjective and objective dimensions of reality, from an emphasis on general patterns confirmed by statistics to one founded on the complex creative interaction between creative individuals and the conforming social collective.

8. Deep Thinking

8.1. Changing Conceptual Frameworks

If mind starts from division and possesses only constructed understanding of unity, the question naturally arises as to what mental faculty is needed to achieve true integration and unification. As Sri Aurobindo observes, mind "thinks, sees, wills, feels, senses with division as a starting point and has only constructed understanding of unity."[38] If the analytic and synthetic faculties of the thinking mind are not sufficient, what alternative is left?

Mathematician William Byers uses the term deep thinking to describe creative intellectual processes that transcend the conceptual limits of existing thought and the rules of logic. He observes that all thinking occurs within a conceptual system. The system may be explicit and implicit, conscious or subconscious. The definition of every word is a conceptual system determined by prevailing cultural norms, social context and individual psychological experience. Every theoretical concept is defined, populated and delineated by defining and limiting perspectives. The boundaries and tenets of any conceptual system are supported and reinforced by forces that resist any assault. Among these forces is the sense of security derived from existing knowledge, the inertial resistance to a major reconsideration of beliefs on which so much has been invested, the egoistic identification with a particular viewpoint, and unconscious bias for elements that conform to its existing premises and rejection of those that undermine or contradict it. Logic and mathematics are conceptual systems. Science itself is a conceptual system. This paper identifies some of the pillars on which science is based that are implicitly accepted as valid, but rarely subject to examination.

Byers argues that all major intellectual breakthroughs involve a breaking out of the existing conceptual system. Since the boundaries of the system are often implicit and unconscious, they are not easily accessible to identification or scrutiny. Therefore, the creative process of transcending the existing system usually begins with the contemplation of questions that are not easily addressed within the existing context. These questions often take the form of conflicting viewpoints, contradictory facts or unresolved ambiguities, which the current framework is unable to assimilate and reconcile within existing premises. The willingness to recognize and embrace the tension of ambiguity, contradictions and paradox releases energy and generates the force needed to breach the boundaries or challenge the fundamental premises of the existing system. The Copernican Revolution and the other major intellectual advances referred to by Thomas Kuhn as paradigm shifts are classical instances of this process.

The process of deep thinking and the obstacles to it are illustrated in Arthur Conan Doyle's stories of Sherlock Holmes. In many cases the police arrive at a conclusion regarding the facts of a crime and the guilty party by carefully constructing a plausible hypothesis that either consciously or inadvertently overlooks apparently insignificant contradictory evidence. In "Silver Blaze" the police develop an airtight theory of how a race horse was stolen and its trainer murdered by the thief and they make an arrest of a suspect with both motive and opportunity to have been responsible. Holmes alone is bothered by apparently insignificant questions. Why didn't the watch dog bark during the theft? By what coincidence was the stable boy served a dinner that was sufficiently spicy to mask the flavor of an opiate? Embracing the implied contradiction which the police chose to ignore, he constructed an alternative hypothesis that led to an entirely different conclusion. The trainer was actually killed by the horse while attempting to maim its ankle muscles so it would lose the race. The deep and lasting appeal of Doyle's fictional character derives from the fact that he points the way to a higher evolutionary pathway.

Viewed in this manner, the possibility of consciously fostering the process of creative thinking is stripped of its mystical shroud. The process requires a willingness to question implicit assumptions and established tenets and the strength to embrace rather than reject or ignore conflicting points of view. There is no guarantee that stepping outside the secure boundaries of an existing conceptual system will necessarily lead to fruitful creativity. It may be just as likely lead to a loss of certainty and confusion. Stepping out is a necessary, but not sufficient condition for mental creativity. But without taking that risk, real creative thinking is extremely unlikely. Byers argues that we have all had the experience of transcending an existing conceptual system in the process of learning about new

ideas. As students we learn to make the leap already made by others before us. Creative thinking requires the ability to make the leap for ourselves. But either way the process is the same.

8.2. Intuitive Knowledge

The instances of scientific discoveries in Physics cited above demonstrate that integration and unification are indeed possible, but they appear to be the work of rare geniuses whose processes we neither understand nor have the capacity to emulate. The testimony of great scientists themselves attributes such discoveries to sudden bursts of insight or leaps of thought rather than linear, systematic rational thought processes. Popper argues that "There is no such thing as a logical method of having new ideas or a logical reconstruction of this process… every discovery contains 'an irrational element', or 'a creative intuition' in Bergson's sense." Einstein speaks in a similar vein with regard to the discovery of universal laws. He refers to an intuitive experience that leads to psychological identification with the object of experience. "There is no logical path leading to these…laws. They can only be reached by intuition, based upon something like an intellectual love of the object of experience."[39] During his brief lifetime, Srinivasa Ramanujan compiled nearly 3,900 mathematical identities and equations, of which nearly all have now been proven correct. The Ramanujan prime and the Ramanujan theta function have inspired a vast amount of further research. When his notebooks were first scrutinized by leading British mathematicians, they responded with skepticism, suspicion and extreme disbelief, for he had arrived at original findings of unparalleled complexity without passing through the traditional process of mathematical proof. When questioned, Ramanujan explained that he saw the theorems in his mind.

Thomas Kuhn regards intuitive thinking as an essential condition for the type of radical change in paradigm associated with scientific revolutions. "Paradigms are not corrigible by normal science at all... normal science ultimately leads only to the recognition of anomalies and to crises. And these are terminated, not by deliberations and interpretation, but by a relatively sudden and unstructured event like the gestalt switch. Scientists then often speak of the 'scales falling from the eyes' or of the 'lightning flash' that 'inundates' a previously obscure puzzle. On other occasions the relevant illumination comes in sleep. No ordinary sense of the term 'interpretation' fits these flashes of intuition through which a new paradigm is borne."[40]

Our understanding of intuitive processes is quite limited, in spite of the fact that throughout history insight and intuition have been cited as the source of new discoveries and new knowledge. We live in times characterized by an unquestioned faith in the power of rational thought, systematic training in logical argument in formal education, and supreme regard for orderly argument based on factual evidence and logical reasoning in judging the validity of any proposition. It is very likely that this extreme reliance on the analytic and synthetic modes of thought impedes the development and exercise of these faculties in our times.

The philosophy and methodology of modern science focus almost exclusively on the tenets of the scientific method to validate hypotheses. So great is the identification of science with analytic and synthetic modes of thinking, that it devotes almost no attention to the creative process of discovery on which its greatest achievements are actually based. One reason for this reluctance to focus on the intuitive process of scientific creativity is the mystique associated with artistic creativity and mystical experiences. If so, then rationality and logic dictate that science should strive to learn as much as possible from these other modes of thinking.

Intuition may be far more common than we think. Today we recognize it only when it is associated with outstanding discoveries recognized by the whole world and in circumstances when it is associated with a number of other traits conducive to high intellectual achievement—high intelligence, the courage to challenge prevailing ideas, an unconditioned mind capable of independent thinking, and intense aspiration that generates the energy and effort for unstinting application and perseverance. It is very likely that the capacity itself is far more prevalent and expressing as creative insight at different levels of society in many fields that go unnoticed. There was a time when the ability to read, write or calculate was considered a sign of genius. Since then humanity has evolved, our minds have evolved and our civilization has evolved so that what was once extraordinary has become the norm. Today the idea of learning to think intuitively may sound outlandish. But it may well be that once we pierce the veil of superstition surrounding it, we will discover means to consciously develop it on a large scale. The first essential step is to remove the stigma or scientific skepticism surrounding ways of knowing that transcend logic and rationality.

9. Limits to Rationality

The term 'limits to rationality' is inherently ambiguous as well as unsettling, even disturbing. It is ambiguous in the sense that it can be used to imply both limits to the extent to which rationality is being applied in the pursuit of knowledge and also to suggest that rationality is itself subject to inherent limits in its capacity to arrive at certain knowledge. For both these reasons the term is also unsettling and disturbing. It is unsettling because we human beings possess or are possessed by such a strong aspiration to arrive at certain knowledge. It is disturbing because it suggests that the mental instruments so far developed and utilized by us in quest of that certainty are subject to inherent limits both in their application and in their powers of discernment.

This historical narrative on the evolution of mind and civilization supports these conclusions. It confirms that even our most sincere, scrupulous, impartial and disinterested seeking for knowledge is subject to limitations imposed by conscious and subconscious perceptions, conceptions, assumptions and perspectives through which we seek for reliable knowledge. As Byers emphasizes, the very nature of a conceptual system is that it is self-limiting. For regardless of how broad and open its premises, it is a construction built and viewed from inside itself and is unable from the vantage point to fully perceive the foundations on which it is constructed. In setting forth the principles on which his geometry is based, Euclid never conceived of a context in which two parallel lines could meet. That conception belonged to a different conceptual framework that was only discovered 2000 years later.

So too, when Newton presented his laws of motion, he never qualified the limits within which these laws held true. He naturally assumed that space and time were invariable constants. The new paradigm conceived by Einstein challenged assumptions that were so basic they had never before been questioned. Quantum Theory challenged notions so fundamental that even Einstein rejected them as implausible.

Our resistance to entertaining premises that contradict established viewpoints arises not only out of an inability to imagine or conceive something different, but also out of a marked preference for justifying the existing system. So strong is this tendency that our reason carefully selects for its attention ideas and evidence in support of its viewpoint and ignores or discounts that which contradicts it.[41] Science has made great advances in establishing criteria for falsifying hypotheses, but it possesses no remedy to the urge of the scientific collective to admire the clothes of the reigning emperor of scientific authority. A greater awareness of the social and psychological barriers to a truly impartial exercise of reason would be a major contribution.

10. Deep Learning

The perspective that emerges from a historical examination of mind and civilization has important implications for education. This paper argues that the principal challenge confronting humanity today is not to fine-tune the incremental progress of knowledge acquisition, but rather to consciously support and accelerate the development of radically different, more synthetic and integrated ways of thinking and knowing.

History confirms that a change in the way we think is unlikely to be made by those already in the middle or later years of life. Most seminal changes in society occur only with the passing of generations raised in and conditioned by the past and with the coming of new generations unconditioned by earlier experience. Education is the principal means developed by humanity to foster conscious social evolution. Therefore, it must necessarily constitute the core of any strategy to accelerate the development of our mental faculties.[42]

One clear implication is that an exclusive preoccupation with imparting more knowledge content is not sufficient and may even be counter-productive, because it only goes to reinforce the existing conceptual framework and analytic skills, and divert energy from the creative enterprise of enhancing our mental capacities.

A few tentative suggestions can be made regarding how future education should differ in method and content from the prevailing.

1. *Balancing Analysis, Synthesis and Integration:* Reality is multi-dimensional and integrated. Consequently, so should effective knowledge of that reality be. It is always shaped by a multitude of aspects, perspectives, forces. The tendency to condense and compress reality into simplistic formulas is a form of willful ignorance that facilitates transfer of knowledge and multiple choice examinations, but conditions the mind to think simplistically and suppress important dimensions of reality. No single statement, no single theoretical perspective can ever be comprehensive. Therefore, the approach to education in all fields should emphasize the multi-dimensional, many-sided character of reality and our knowledge of it. Education in all subjects should stress the complexity of knowledge rather than reduce it to simple formulas to be memorized. It should encourage young minds to examine contrary, opposing and contradictory perspectives. Precise mental knowledge of the totality is never possible, most especially with respect to the complexity of human experience. Therefore, a precise analytic knowledge of the individual contributing elements should be balanced by a holistic vision of their harmonious integral relationship to and within the whole. The capacity of the mind for differentiation and delimitation must be transcended by also fostering an intuitive faculty for integration and unification.

2. *Reuniting the Surface and Depth, Objective and Subjective Dimensions:* As there are multiple dimensions to reality, there are also multiple levels or depths. Effective education should simultaneously cultivate observation, perception and perspective at multiple levels of reality. These levels are represented in the natural sciences by the physical, chemical, biological, genetic, metabolic, neurological and other processes present in the functioning of all living beings. The discoveries of Copernicus, Einstein and Heisenberg arose from a willingness to reexamine fundamental premises. In the human sciences, reality is governed by myriad mental, emotional, vital, social, cultural, technological, organizational and environmental factors that provide the foundation and context for all social phenomena. A comprehensive study of the factors leading to the Italian Renaissance, abolition of slavery, the Great Depression, the two world wars, the end of colonialism, the founding of the UN, the beginning and end of the Cold War, the hippy movement, the birth of the European Union and the Internet, climate change, the 2008 financial crisis, Occupy Wall Street, and the European refugee crisis would be illustrative. In each case comprehensive knowledge must necessarily include an understanding of prevailing ideas, intellectual atmosphere, beliefs, aspirations, anxieties, threats, emerging evolutionary social forces and values, opposing vested interests and reactionary forces, and emotional sensibilities. It should include a view of surface movements, distinct and separate elements, oppositions, conflict of forces, fine shades of variation and individuality. It should also include a perspective based on the underlying oneness, inner unity, harmony in law of movement or being, greater reconciliation, the center from which all aspects emanate and to which they return.

3. *Reconciling Contradictions:* As Niels Bohr said, "It is the hallmark of any deep truth that its negation is also a deep truth."[43] In each area of observation, education should cultivate a sense of the complementarity between difference and oneness, subjective and objective, individual uniqueness and collective type. Rather than categorizing reality in terms of simple polar opposites, education should develop varying perspectives arising from different viewpoints and different levels of consciousness and experience. What appear as contradictions at one level and from one perspective represent complementary aspects of reality from a

wider or deeper perspective. Studying things from the differing perspective of the mental, vital-social, and physical planes will foster a capacity to clearly distinguish these movements, separate and better control them.

The approach will naturally vary and is too complex to be dealt with in this paper. One example may suffice to illustrate some of these aspects. In March 1933 Franklin D. Roosevelt become President of the United States in the midst of the most severe banking crisis the country had ever faced. Since the Great Crash in 1929, more than 6000 US banks had failed and closed. Daily millions of Americans were lining up at the remaining banks to withdraw their savings before their bank also declared bankruptcy. During the previous three years every economic policy initiative thought to be relevant had been applied, but failed to stem collapse of the system. FDR knew that the principles of economics he had studied at Harvard were inadequate to stem the crisis. He understood that the collapse of the system was the result of subjective factors that could not be readily addressed at the institutional or policy level. So he addressed the American people on radio in the first of what became known as his fireside chats. He explained to them that all the objective factors that had made America prosperous were still present—the rich natural resources, hard-working people, huge industrial infrastructure and continental market. He diagnosed and told them that the real problem was not any objective factor. It was rather their own loss of self-confidence and faith in America. He appealed to their courage and national pride. In immortal words, he told them that the only thing they had to fear was fear itself. During that week legislation was passed instituting insurance on bank deposits and other safeguards. He asked the people to return to their banks on the following Monday and redeposit their hard earned savings. Once again long lines grew in front of the banks, but this time most of the people had come to redeposit their money and the bank crisis subsided.

This famous event illustrates several important aspects of the change needed. First, it illustrates that economy, politics, society, and culture are inseparable dimensions of a single integrated reality. The perennial public debate over the role of government in regulating markets is misplaced. There are no markets without government regulation. Without an infrastructure of law to protect property and contract rights, without a judicial system to enforce those rights, without public institutions to prevent collusion and monopoly control, no market can be free and functional. So too, any economy is dependent on the prevailing social norms, values, educational system, and a host of other social factors. Development of a real science of economy will only be possible when economics is viewed as a subset and integral aspect of the larger society of which it is a part.

Second, this event illustrates the equal or greater importance of underlying subjective factors in the effective functioning of society. Every economics student is taught that the economic system is founded on trust and confidence. Without it money has no value and financial institutions cannot function. But although it is recognized as a necessity, it rarely figures in the prevailing conceptual framework of economy, because economic theory is so strongly grounded in objective, material factors. Like every social institution and activity, economic performance is the result of conscious choices of countless conscious individuals. Those choices depend not only on their confidence in the system but also on their theoretical understanding of how it works. Money is commonly regarded as an objective reality, a thing in itself. In fact, money is merely a convention adopted by human beings as a symbol of social power. Money has no value outside of a social context, e.g. on a desert island. Like language, it is a networking tool to facilitate interactions between people. The value of money depends on the overall productive capacity of the society which is founded on the knowledge, skills and values of its individual members.[44]

Third, this event dramatically illustrates the role of the individual in social development. Mainstream economics and social science deal with broad generalities and statistical averages. The individual is just a number. But in reality, the individual is the source of all creativity and innovation in society. As education is the instrument for conscious social evolution, the individual is the catalyst for the evolutionary process. History documents the fact that a single individual thinker, leader, inventor or entrepreneur has the power to change the world. Indeed, as Margaret Mead once said, all significant changes in human history have been the result of actions by small groups of individuals.[45]

This incident also illustrates the fundamental paradox that crises are opportunities. FDR's remedy for the banking crisis of 1933 led to measures which provided for the stable development of the American financial system for more than six decades until the protective measures were systematically withdrawn in the 1990s, resulting in the 2008 financial crisis. So too, history confirms that virtually every tragic event has had positive consequences. The Black Death in Europe led to the collapse of feudalism, paving the way for the rise of democracy. Two horrendous world wars led to the founding of the UN and the international charter of universal human rights. This brief narrative is only intended to illustrate that every known fact, event and concept acquires greater significance when viewed from a more comprehensive, integral perspective.

11. Evolution of Knowing

This narrative traces broad developments in the history of mind, its faculties and the quest for knowledge. It highlights some of the relationships between the evolution of our subjective faculties for self-awareness and knowledge and the evolution of the external facets of human civilization. The historical record reveals a one to one correspondence between inner and outer. The development of mental faculties and mental conceptions has led to the progressive development of our collective social existence. It also reveals the dependence of that mental development on the openness, tolerance and active support that society offers to the exploration, dissemination and application of new knowledge. This interplay between inner and outer, mind and civilization, the individual and society, human consciousness and the institutions we create has been a central determinant of the course of human evolution.

Today humanity confronts intractable existential challenges. Given our history, it seems plausible to assume that the problems we face correspond to limitations in the ways we are employing our mental faculties. Given the extraordinary developments that have taken place in the past, it seems equally reasonable to assume that we have not yet exhausted the limits of human consciousness, individually or collectively. Challenges are opportunities. Crises are a spur to evolution.

Mind has a remarkable capacity for adaptation and development. But it also reveals a tendency to tenaciously cling to its past achievements, adamantly persist in its present line of activity, resist evolutionary departures and circle around for long periods in repetitive affirmation of what it already knows and believes. Our current preoccupation with physical, technological and organizational solutions to problems is an instance of that repetitive tendency. The perspective of history reveals larger movements and longer cycles that vary from age to age, civilization to civilization. It may well be that we are approaching the end of one of those cycles and need to prepare for a more significant reframing of the basis for knowledge and civilization in the age to come.

11.1. Science, Philosophy and Religion

Symbolism, intuitive insight, metaphysical intellect and experiment science have all made important contributions to the evolution of civilization. Stages can be identified in which each of them has played a dominate role in deciphering and representing reality. The profound truths of existence arrived at by the great religious traditions were the result of direct spiritual experience which could not be rendered into logical discourse or confirmed by the experimental methods of modern science. So too in great periods of philosophy, the rational mind sought for answers to questions that still and in all likelihood will always lie beyond the purview of experimental science. Science in turn has uncovered patterns, laws and formulas in the mysteries of physical nature that generate a sense of wonder as profound as the visions of mystics and logos of sages.

All three have contributed to the collective quest of humanity for knowledge. At different periods of history, each has attempted to dominate the other two, even to the extent of nearly or completely eclipsing their role. Science and philosophy developed side by side in ancient Greece and during the enlightenment. The breakdown of dialogue between them acquired the character of a divorce only in the second half of the 20th century.[46] Today intellectual discussion regarding fundamental questions of nature has very largely been supplanted by experimentation and data-based analysis within existing conceptual framework of modern science.

Experimental science, philosophic speculation and spiritual experience represent developments of three different and complementary powers. They only appear contradictory from the narrow vantage of any one perspective. That explains why even in our advanced scientific culture, great scientists point to intuition as the source of their greatest creative contributions to the progress of knowledge. Thus, the cryptic formula in the Upanishads "*One indivisible that is pure existence"* and in the Bhagavad Gita *"Indivisible, but as if divided in things",* were rendered into intellectual statements about oneness, unity, and union by the classical Greek philosophers more than a thousand years later and confirmed by science in the discoveries of physicists two thousand years after that.*

The persistent intellectual and practical problems humanity confronts today are an opportunity to recall that our powers of knowing as well as our body of knowledge are evolving simultaneously. The apparent limitation of present knowledge is a reminder that the progress of knowledge depends on expanding our field of vision to encompass wider ranges of reality and deepening our perception from the observation of external appearances to integrate and unify the objective and subjective dimensions of reality.

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The Integration of Knowledge

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Abstract

The exponential growth of knowledge demands an interdisciplinary reflection on how to integrate the different branches of the natural sciences and the humanities into a coherent picture of world, life, and mind. Insightful intellectual tools, like evolutionary Biology and Neuroscience, can facilitate this project. It is the task of Philosophy to identify those fundamental concepts whose explanatory power can illuminate the thread that leads from the most elementary realities to the most complex spheres. This article aims to explore the importance of the ideas of conservation, selection, and unification for achieving the goal.

We live in a fascinating time for the integration of knowledge. In particular, we have developed three great theoretical pillars whose immense explanatory power is destined to contribute to the unification of knowledge, a goal sought by so many visionary minds throughout the centuries: fundamental physics, evolutionary biology and neuroscience.

1. Physics, Biology, and Neuroscience

Physics has accomplished the feat of condensing the structure of the universe in a succinct elenchus of equations, such as the field equations of general relativity and the Schrödinger equation. It has not discovered *the* equation that rules the complete description of the universe, but it has notably approached this titanic dream; a utopia illusory for many, yet unquestionably legitimate. Physics is built upon two fundamental models: general relativity and quantum mechanics. We do not know how to harmonize these two divergent pictures of reality. General relativity offers a geometrical theory of gravitation, where the idea of relativity of all inertial frames of reference is generalized to cover accelerated frames of reference. It has led to the formulation of covariant equations whose sophisticated mathematical expression—through the language of tensor calculus—has given us the finest, deepest, and most rigorous description of the large-scale structure of the cosmos. According to the theory, gravity emerges as the effect of the geometry of space-time, as the result of the curvature produced by the presence of a density of energy and momentum.

However, for understanding the three remaining fundamental forces of nature, quantum mechanics has proven uniquely powerful. Unlike general relativity and its geometrical image of force, quantum mechanics recapitulates our understanding of the physical world through a theory of fields in which the force is mediated by a set of elementary particles of bosonic nature.

The 20th century has therefore seen a formidable extension of the unifying power of the human mind. Major advances in the domain of the physical sciences have stemmed from the epistemological questioning of their basic concepts. Neither the work of Einstein nor the developments in quantum physics can be fully grasped without the examination of this profound immersion, with vivid philosophical resonances, into the fundamental categories of physics and the logical criteria required to stipulate a meaning for our notions about the objects of experience. With Einstein, ideas like space, time, simultaneity, and privileged states of motion underwent an exhaustive interrogation. This reflects a search for concepts that could be unambiguously assigned to the properties observed in the course of experiments. An analogous comment can be made about Heisenberg, whose famous Uncertainty Principle (a humbling truth for humankind) is the fruit of a careful revisiting of the meaning of basic kinematic and mechanical concepts.

This criticism of our intuitive notions has triggered key theoretical—and therefore also practical—advances, propitiating the fusion of pure thought and empirical knowledge. It constitutes the most faithful reproduction of the intimate functioning of a human mind in its restless quest for unification.

Biology, the science that tries to understand the world of life, bestows upon us a wonderful unifying tool: the theory of evolution. This model unifies ecological, morphological, and genetic knowledge about living beings. Through the lenses of evolution, the elucidation of the history of life allows us to delve into the structure and explore functioning of biological entities.

Neuroscience is on its way to developing a unifying instrument of immense power and amplitude: the scientific understanding of mind. From the level of the nerve cells to the sphere of the activity of the brain as a whole (the synchronization of its different regions), progress has been steady, though insufficient. As soon as we understand how the mind works, the origin of its abilities and the scope of its capacities, we shall be ready to unify the domain of the Humanities, a goal which until very recently seemed unattainable for science, as if it were fragmented in irreconcilable approaches and inimical cultures. Through a neuroscientific theory of mind we will be able to examine the source of the human being's symbolic creations. This task will contribute to building the neuroscientific foundations for the study of society, law, religion, and art.

2. Conservation, Selection, Unification

One of the neuralgic principles of reality elucidated by the physical sciences refers to the idea of *conservation* of certain quantities in the processes experienced by the objects of nature. According to Noether's theorem, we know that any differentiable symmetry is associated with a law of conservation. The most important concept used to express this principle of the working of nature is *action*, perhaps the most relevant and profound of all physical categories. Invariance under time translation yields the principle

of conservation of energy; invariance under space translation yields the principle of conservation of momentum; invariance with respect to rotation yields the principle of conservation of angular momentum. In quantum physics, a gauge symmetry related to the conservation of charge has also been discovered. In summary, physics has unfolded principles of conservation which, from the realm of subatomic particles to the domain of thermodynamic systems, are capable of establishing laws of apparent inviolability (the status of the principle of conservation of energy in a cosmological scale is under discussion).

In biology, the category of *selection* is as important as the concept of *conservation* is in physics. Transmitted through the power of replication that living beings possess, variability is selected by the environment in accordance with its reproductive efficiency.

If we ascend in the scale of material complexity and reach the universe of human consciousness, is it possible for us to identify a principle endowed with similar theoretical power? I believe that such a principle is the idea of *unification*. The conscious mind unifies the perceptions which it receives. The result is the integration of data susceptible to subjective assimilation. With the exception of some sensory systems (like the visual system), we do not know the precise mechanisms through which this phenomenon occurs, but we do know that the human mind holds the unusual privilege of unifying the multiplicity of the world through the filter of its rationality. This unitary grasping of reality (Kant's "unity of apperception" in the *ich denke*) means the insertion of nature into logical patterns that consciously revert to the subject. It is one of the most remarkable progresses in the long path of evolution, for it represents the dawn of knowledge as the most powerful force of life and the pinnacle of its activities. Knowing involves unifying, connecting, integrating that which is different on the basis of shared relations. Behold the most genuine meaning of the Greek term *logos* and the philosophical scope of the verb *legein* since Thales and the pre-Socratics.

3. The Unity of Nature

These three notions (conservation, selection, and unification) are not strictly discontinuous. Any hypothetical tripartition of the universe in matter, life, and consciousness obeys instructive and epistemological schemes, not reality as such, independent from the judgement of human intelligence. Along its history, nature has been capable of rising on its own from one level onto another, and this suggests a profound ontological continuity between all realms of reality. It is in fact possible to draw a narrow analogy between a principle like the law of stationary action in physics (the action integral of a particle will manifest extreme values—i.e. maximal or minimal—so that the value of action may be stationary) and the idea of natural selection, a mechanism that seeks an optimal point in the relationship between genetic variations and the surrounding environment. Also, to unify, the act of integrating perceptions in a unitary consciousness of external and internal reality can be contemplated as a simultaneous optimization in the value of the information coming from the world and the information elaborated by the subject, with the goal of reducing the boundless multiplicity of phenomena into the unity of the conscious being. An entity capable of extracting, from the copious concatenation of stimuli, information of greater value, more profitable and meaningful, is certainly more conscious of the world and its own being.

The reduction of chemistry to physics has been accomplished, thanks to the quantum theory of orbitals. Our deep understanding of how electrons are distributed in atoms is illuminated by quantum principles like Pauli's exclusion principle. Physics has therefore conferred upon human rationality an appropriate tool for understanding the periodic table of elements and the organization of chemical elements. The almost infinite universe of inorganic and organic reactions can be harmoniously inserted into the scientific view of the world that emanates from the physical sciences, from its small but powerful elenchus of laws and fundamental forces. This is one of the most admirable achievements of quantum mechanics: the complete explanation of the atomic structure of elements and the justification of their principal physical-chemical properties. With no need to incorporate theoretical principles of substantive newness, or principles that cannot be easily deduced from basic laws, physics has allowed for a fluid integration of the vast domain of chemistry.

Evolutionary biology covers a new semantic field of science: life. Of course, it is based upon the fundamental laws of physics, mediated through chemistry (specifically, organic chemistry, which elucidates the structure of compounds like aminoacids and nucleic acids). However, it assumes a series of concepts which are virtually absent in the domains of physics and chemistry. These notions are essential for our understanding of life and its development. They are crystallized in the theory of evolution, a model of exceptional explanatory power. We should not forget, however, that we lack a complete theory of evolution. Research in the fields of genetics and epigenetics could actually lead to a substantial revision of some fundamental concepts of evolutionary biology. Nevertheless, as a paradigm, the evolutionary frame has not been surpassed, and it is highly improbable that it will be substantially overcome in the future, at least in its capital aspects. But just as classical physics was not suppressed by 20th century physics, which rather showed the limits of its approach and expanded its theoretical power, future progress in biology can actually broaden the scope of this science and enlarge its categories.

The thread behind the transition from physical chemistry into biology has not been entirely elucidated, for we do not know how life flourished from inert organic matter. However, it is legitimate to hope that we shall soon solve this intricate problem. It is reasonable to think that life on Earth appeared by virtue of a set of chemical conditions which facilitated the creation of molecules susceptible to replication, whose increasing degrees of autonomy from the environment allowed them to induce certain metabolic reactions in the interior of cells. But in the absence of a fully convincing itinerary as to how inert matter conquered the domain of life, we still have to distinguish physics from evolutionary biology, even if a congruent framework with the scientific view of the universe clearly points to the existence of profound coherences and continuities between the inert and the living worlds.

The impossibility of reducing the biological level to the physical-chemical level does not stem from an intrinsic prohibition but from the overwhelming complexity of the system. As soon as we unveil the origin of life, there is no *de iure* interdiction forbidding the unfolding of the fine thread connecting the world of chemistry and the realm of biology. Of course, the complexity of biological

systems is not the sole result of their intrinsic elements but of a factor which becomes extremely relevant for biology: the effect of contingencies. The study of life demands knowing the prolix historical itinerary through which organisms have passed. History contains necessity but above all it is permeated with contingency. Only Laplacian intelligence could have foreseen the arrival of a meteor whose devastating consequence for most of living species triggered the massive Cretaceous extinction. Also, we know that there are unsurmountable uncertainties in the quantum scale. Therefore, the integration of knowledge cannot seek to eradicate any trace of contingency or to reduce every explanation to a physical proposition, but should rather serve to expose the inextricable imbrication that binds all domains of reality. This goal highlights the power of the human mind to perceive the fundamental principles behind the unity of such heterogeneous spheres.

In considering history, we cannot override the shadow of contingency. However, we can understand the human constants that pervade spaces and times. Thanks to the scientific study of mind, it is possible to understand human motivations, their logic and—why not?—the seeds of their admirable creative capacity. This yields a fundamental framework for understanding great civilizations and the most sublime productions of the spirit. Even without exorcizing the specter of contingency, it is still feasible to identify the fundamental axes around which human action gravitates. In our days, this knowledge comes from the neurosciences.

It is not utopian to dream of an explanation for the neurobiological bases of consciousness. Again, this goal does not exhaust the understanding of every specific consciousness, because this power of *Homo sapiens* is nurtured by sustained interaction with both the external and the internal environments. It is utterly impossible to reproduce every single detail that forms the vivid experiences of conscious subjects (we would need a rigorous replication of every physical and psychological condition in which this capacity is manifested, as if we were trying to draw a 1:1 scale map). But this deep obstacle does not prevent us from uncovering the neuroscientific foundations of consciousness, which probably lie in certain anatomical structures responsible for connecting perceptual and associative areas, like the claustrum and the superior longitudinal fasciculus.

4. The Integration

Science is in possession of the most rigorous and universal language that the human mind has developed: mathematics. The progress of this discipline over the last few centuries, especially in the elucidation of its fundamental principles, its scopes and limits, has granted us an unsurpassed formalism for describing the structure and functioning of the universe. We know, however, that this depiction of reality cannot be complete for at least two reasons: first of all, these models tend to use the language of differential equations, while our knowledge of matter has revealed the discontinuity that exists in the fundamental levels of nature, in particular at a quantum scale. Secondly, the use of mathematical language compels us to draw a distinction between formal and material equality. When, in the field equations of general relativity, we find the number π and in the Schrödinger equation we contemplate the imaginary number i, it is clear that the notion of equality needs to be interpreted as the equivalence of pure objects of thought (abstractions which do not necessarily enjoy ontological independence in the realm of nature). The mathematical expression of physical categories represents the deepest and finest approach to the material universe conceived by the human mind, but only in an asymptotic limit, in whose ideality material objects fully converged with the pure objects of thought; it would be correct to say that one member of the equation is strictly equal to another.

The indubitable advantage of mathematical language resides in its versatility, for it is flexible enough to cover the practical totality of natural registers. The invention of new mathematical tools throughout history is the best proof of this fruitful plasticity. This is the reason why the limits of thought do not inexorably seal the frontiers of being. Against Parmenides' thesis, the realm of mind is eminently ductile and it can adapt itself, both in its language and its categories, to the pressing challenges posed by reality. We have even managed to expand the limits of our imagination. Before Cantor, it was generally accepted that infinity could not be properly scrutinized by reason. After Cantor, we have learned that different types of infinity exist and that we can have infinite sets which are numerable. The borders of thought have been wonderfully extended, helping us discover unexplored territories of both the real and the possible.

Beyond the difficulties, it is admirable to reflect on the achievements of our Promethean longing for knowledge, in our indefatigable desire of grasping the vastness of the universe in the lightness of the concept. Every act of cognition is guided by logic, whose premises and operative rules articulate human reasoning. However, its quantitative expression has only reached an adequate expression in sciences like physics, chemistry and—to a lesser degree—biology. Attempts at extrapolating this language onto social studies have been successful only to a limited extent. But logic is equally applied regardless of the field of knowledge. A physicist's mind is not governed by different logical rules compared to the mind of a philosopher. Any advance towards the improvement of our logical categories and the unveiling of their possibilities, their elasticity and foundation, will provide the human intellect with new and more acute tools for apprehending realms of reality which until now have remained beyond the scope of our knowledge.

Of course, the struggle to integrate knowledge by founding the most complex realities upon the simplest ones cannot be claimed to exhaust our understanding of reality. The world will surely never cease to amaze us with unforeseen wonders, and blessings for our intellect. But the richness and inexhaustibility of the world do not prevent us from identifying the fundamental principles behind its vast and astonishing nature. Our mind, our logic, our intuition…, must be in a constant state of improvement through their interaction with reality, so that the deciphering of the basic axes of the universe will also unveil the true possibilities of human intelligence, of its logic and its language.

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Insights on Creativity

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Abstract

Everyone will acknowledge the importance of creative thinking skills, but only few truly understand the process of creative thinking. Creativity is not merely an act of genius or luck, but is a process that can be learnt and the catalysts for creativity can be identified. This article presents the conclusions of the roundtable on Mind, Thinking & Creativity, conducted by WAAS and WUC at Dubrovnik in November 2017. Mind is the principal tool that we use to seek knowledge. *Tapping into the mind's fullest potential will unleash creativity and innovation. A greater understanding of the nature of mind and its faculties helps us recognize the limits to thinking and rationality. Transcending the limitations of mind allows us to formulate comprehensive solutions to the problems and challenges faced by humanity.*

According to the 2016 Workforce-Skills Preparedness Report by PayScale Inc., 60% of employers complained that the college graduates they hire are not ready for the workplace, as they lack critical thinking and problem solving skills. A recent article in the Wall Street Journal points out that average college graduates show no improvement in critical thinking skills after four years of college. A vital skill that marks the employability of a person is not taught in school, as the concept of creativity remains a mystery to many. The inherent capacity of mind is to view reality from only one perspective. Creative thinking is the process of connecting, reconciling and unifying unconnected ideas by taking a wider perspective. Genius has the capacity to discover the truth in opposite viewpoints and to reconcile ideas that appear to be contradictions.

Mind's characteristic mode of functioning is division and aggregation. Mind has the tendency to divide and subdivide reality into smaller parts that result in fragmentation of knowledge. Aggregation, the complementary nature of mind, assembles the parts to construct the whole. But the essence of reality is lost as mind falsely assumes each of the parts as the whole or the sum of the parts as the undivided whole. Integration and Unification are acts of creativity that surpass this analytic function of mind and develop a holistic approach to understand the world in its complexity and totality.

Mind mistakes symbolic abstraction for the reality it represents. All concepts, theories and models are symbols that represent reality to a certain capacity. Verbal and written forms of communication condense and transform the personal insights and experiences of an individual into symbols which are passed on to others. Such abstraction, association and generalization tend to objectify knowledge and remove the context of life. Education is the communication of the collective wisdom, gained from centuries of experience, to the future generations. The accumulated knowledge of past generations that is organized in an abridged form is fruitful to the individual only when he can see its relevance to his life.

The rules of logic and reasoning are developed to go beyond the sense data to refine our thought processes. Rational thinking is to take all the facts that we know and see if they are consistent within all our observations. The value of a thought lies in the consistency of all the known facts. To expand knowledge is to expand and widen the sphere of consistency. Creativity is the capacity to think beyond the limits of an existing conceptual system. Mind is limited by its own assumptions and draws conclusions predetermined by its own premises. Creativity arises from embracing ambiguity and discovering reason in the irrational.

The Roundtable concluded with a core set of recommendations on how these insights can be applied in classrooms. The findings were presented and discussed at the 2nd International Conference on Future Education in Rome on Nov 16-18, 2017.

1. Active, Student-centered Learning

Creativity of mind occurs in an atmosphere of freedom, engagement and interaction. Activities in the classroom should be structured around the students, rather than subjects, giving them freedom to raise questions, voice their ideas and interact with one another in pursuit of knowledge. This will develop students' capacity to see beyond what exists and open their minds to new ideas. An interactive classroom fosters active, experiential learning, whereas the current system of education encourages rote memorization and regurgitation of facts. Teaching strategies should develop and exercise the students' mental faculties for conceptualization, judgment, analysis, discrimination, organization, problem-solving, value-based decision-making, integration of knowledge and imagination. The focus should be on learning how to learn by learning about the validity of different ways of thinking and viewing reality.

2. Understanding Complexity, Reconciling and Integrating Differences

It is difficult for mind to perceive relations of cause and effect when the causes are complex. Creativity is needed to integrate knowledge of complex phenomena and to evolve effective solutions that embrace all contributing factors, avenues and opportunities. From early childhood, the emphasis should be to develop in the child an understanding of the complex interrelationships and interconnections that govern the way the world works and to look for underlying principles and factors that relate and unite things that appear unconnected, opposite or even contradictory.

3. Seeing the Whole Picture in Context

The key to comprehending complexity is to view phenomena in context rather than merely understand them in abstraction. Specialization divides, focuses, narrows and limits understanding to its individual component parts, fragmenting knowledge in the process and separating it from the contextual reality to which it applies. Discovering how to derive abstract generalizations from myriad diverse facts should be balanced by the capacity to apply abstract principles appropriately to fit the complexity of the real world, rather than reducing action to simplistic formulas. Transdisciplinary education helps us become aware of the limitations and traps of compartmentalized knowledge.

4. Independent Thinking

Real creativity requires the capacity to question established beliefs, prevailing theories and conventional wisdom. Learning is a social activity which is too often constrained by the authority of those who teach and the social acceptance of that which has already been discovered. At its heart science is a process of endless discovery of greater knowledge, rather than a set of orthodox truths to be passed on and accepted religiously. Students should be encouraged to question, explore, challenge, debate and rediscover for themselves rather than to memorize, accept, repeat and regurgitate what they are taught. Students must develop the capacity to acquire skills that can be applied to many fields and be flexible. The ultimate aim of education is not transfer of knowledge but rather development of an independent mind and individual personality capable of making conscious value-judgments and acting on deeper convictions. Rather than merely a means to a job, education is the process of learning how to live successfully, happily and harmoniously as an individual and responsible contributor to the progress of society.

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SECTION 6
TRANSDISCIPLINARITY: BREAKING THE SILOS

UNIVERSITIES: Enhancing the Education, Research and Innovation Base

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1. Multi-/ Inter-/ Transdisciplinary Education

The social, scientific and technologic conditions for the development of ideas, of knowledge and of solutions to problems have changed dramatically over the recent decades. The globalisation of information, of work, of ecologic aspects, to mention just a few, has made a tremendous impact on our life. Problems have become more complex and their solutions require a new thinking which has to take into account the influences from multiple sources in our world. Edgar Morin once wrote the following:

> *"Nous savons que le mode de pensé ou de connaissance parcellaire, compartimenté, monodisciplinaire, quantificateur nous conduit à une intelligence aveugle, dans la mesure même ou l'aptitude humaine normale à relier les connaissances s'y trouve sacrifiée au profit de l'aptitude non moins normale à séparer. Car connaître, c'est, dans une boucle ininterrompue, séparer pour analyser, et relier pour synthétiser ou complexifier. La prévalence disciplinaire, séparatrice, nous fait perdre l'aptitude à relier, l'aptitude à contextualiser, c'est-à-dire à situer une information ou un savoir dans son contexte naturel."*

Morin goes on to say that it is not enough to value the links between experiences, disciplines, creativity and ideas. One has to develop methods, strategies and practices that will transform those links into real connections. We have to recognize interdependence in order to actualise it and we have to know how to act once we have developed that recognition.*

1.1. Definitions

Discipline = sub-field of science, of engineering, of humanities, etc. with its specific perception, concepts, language, methods, tools, aiming to analyse, understand, describe parts of Nature.

Multi- (Pluri-) disciplinarity = several disciplines work together in parallel on one subject. Its goal remains limited to the framework of disciplinary activity.

Interdisciplinarity = the concepts, methods of one discipline are used in the work of another discipline (transfer of methods, etc. from one discipline to another). Its goal remains within the framework of disciplinary activity.

Transdisciplinarity = holistic activity contributing to a more general understanding of the world, one of the imperatives being the unity of knowledge—a way of thinking that sees all aspects of the world interrelated through patterns of interdependent systems. These include natural, social, economic and political systems. Transdisciplinarity genuinely transcends "disciplinarily by cutting across disciplines, integrating and synthesising content, theory and methodology from any discipline area which will shed light on the research question/s".†

Transdisciplinary research is not antagonistic but complementary to multidisciplinary research. It is nevertheless radically distinct from multidisciplinarity and interdisciplinarity because of its objective; the understanding of the present world, which cannot be accomplished in the framework of disciplinary research. The frequent confusion between the different M/I/T-disciplinary approaches is harmful as it hides the differences in aims of these three complementary approaches.

Essential requirements for any transdisciplinary work are curiosity and patience; understanding of other disciplines and their languages takes time and commitment. And so does I/T-disciplinary teaching. Transdisciplinary research and teaching do not respect institutional boundaries.

1.2. Challenges for I/T-disciplinary activities

Certain characteristics inherent to I/T-disciplinarity challenge new ways of undertaking research:

- *Language*: Each discipline creates its own jargon. I/T-disciplinarity requires the appropriation and accommodation of different languages. Communication of I/T-disciplinary research results and teaching proves to be difficult since it requires the use of technical terms borrowed from one discipline which are not well understood by the actors from the other discipline.
- *Methods*: Disciplines are often devoted to their own methods of investigation. This may lead to misunderstanding and opposition.
- *Institutional constraints*: Institutions are mostly disciplinarily organised creating barriers for I/T-disciplinarity. On the other hand, strong disciplines are necessary as any interdisciplinary activity starts with a profound understanding of single disciplines.
- *Cognitive constraints*: It is very difficult to become expert in two or more disciplines. An in-depth knowledge of different disciplines is however the requirement for genuine I/T-disciplinary research. This raises the question of the impact of these difficulties on education and on the institutionalisation of interdisciplinary training programs.

* [R. Burnett "Disciplines in Crisis: Transdisciplinary Approaches in the Arts, Humanities and Sciences", http://www.eciad.bc.ca/~rburnett/]

† [W. Russell "Forging New Paths – Transdisciplinarity in Universities", www.wisenet-australia.org/issue53/transdis.htm]

- *Assessment*: Experts (reviewers) for evaluating the results of M/I-disciplinary research and education are missing. Standard bibliometric information is scarce and not representative. It is therefore difficult to evaluate the quality of such activities. New ways of quality assessment are to be developed.

1.3. Stimulating I/T-disciplinarity at Universities

The potential and success of I/T-disciplinary activities at an institution depend essentially on the outstanding quality and seriousness of the participants in the projects. Excellence of researchers and favourable boundary conditions for learning and searching across the disciplines are prerequisites for any good I/T-disciplinary work. The following actions help stimulating I/T-disciplinarity:

- Retain and reinforce strong disciplinary institutes, this is the basis of any serious cross-disciplinary research.
- Create flexible structures which allow crossing disciplinary boundaries.
- Avoid creation of new boundaries between interdisciplinary groups, once established.
- Initiate I/T-disciplinary research through university projects.
- Create close collaboration between regional and supra-regional centres of excellence.
- Select strong personalities who have I/T-disciplinary experience as leaders.
- Form small groups of highly motivated participants in the project.
- Create specific structures for assessment of results

1.4. Learning interdisciplinary research

- I/T-disciplinarity cannot be taught—it has to be learned by doing research.
- I/T-disciplinarity requires mastering of more than one discipline in depth. Superficial learning of several disciplines does not lead to I/T-disciplinary research and corresponding solutions to address complex problems.
- Learning the essentials of several disciplines has to be done consecutively, not in parallel (for example: doctoral studies in one discipline and post-doctoral work in another).

2. Innovation in Science and Technology by new inter/Trans disciplinary Approaches

2.1. Importance of Inter/Trans disciplinarity for Universities

Inter/Trans disciplinarity matters because, in the real (as opposed to academic or university) world, most (scientific-technological–social) problems do span different disciplines: in future, post-graduates have to operate in a multi-disciplinary environment, unknown in the past.

Inter/Trans disciplinarity of today is "specialty" of tomorrow! For example; a graduate with three master degrees in biology-informatics and engineering, may—in future—be better off than with one PhD in biology or ….

The real need is for our young scientists to know how to move forward when faced with a real-world problem on a technical topic they have never met before, on a real-world time-scale, and a real-world budget.

Somehow, the present generation of students must be convinced that they would have good careers if they take a research route in their early years. Most will not stay in academia, or even in academic research, and universities should recognize this in their courses.

In universities, inter-departmental barriers are very high. One useful approach is to have teaching the responsibility of new departments e.g. Natural sciences replacing actual physics—chemistry, biology etc., with research also being done through various types of University Research Centres.

Interdisciplinarity is absolutely necessary to approach modern research problems with complete coverage of the expertise essential to solve the scientific problems involved and the proper interface with the (industrial) application. In other words, future research should be aimed at solving problems where many traditional disciplines (chemistry, physics, biology, engineering ….) are contemporarily involved. For example; the rapidly emerging fields of biomimetic -, intelligent- and nano materials and systems will be the most important technologies of the 21st Century. They will require the input of researchers from solid state and organic chemistry, biology and medicine, physics and mathematics, informatics, and engineering if their potential is to be fully realized.

The driving force or rather the objective of a research project is today determined by a real social need but the activity necessary to give the proper answer has to be performed, looking up to the common objective, by researchers having different advanced expertise but speaking a transunderstandable scientific language and enter into other ways of thinking. This language/culture can be created only during the training of researchers and must be part of their curriculum. This implies that the University courses must be broader and open to related disciplines thus giving the students the predisposition to interdisciplinary activity after graduation.

Inter/trans disciplinary elements could put the University in the position to cultivate graduates with the proper attitude to work in academic and industrial research and technology without the present conceptual separation and develop internal research groups ready to react properly to the technical problems offered by the society and industry.

The educational system in Europe still relies on two paradigms:

- the classification of different sciences according to Auguste Comte,
- the hierarchy of lectures/tutorials/practicals in our pedagogical practices.

The need for multidisciplinarity will force a rethinking of these two paradigms. Rather than trying to remove barriers between disciplines, we should think of not building them in the first place: project work should emphasise to students that the scientific method is universal, and the various sciences are not independent of each other, but all rely essentially on the same scientific method. If we want the next generation to be able to create these new fields, to approach these new scientific challenges with innovative minds, we have to train them in two ways: not just a technical approach to science, which is the current method, but a cultural approach to science which will develop their inquisitiveness.

The primary function of universities should be to educate students and perform innovative and horizon-broadening research. Universities also need to be flexible enough to establish new interdisciplinary, interdepartmental centres for working on the scientific fields of tomorrow.

Many breakthroughs in science are expected over the next decade, revolutionizing the way we manage and interact with our environment. The promotion of science education and careers to the young generation is done in the name of education.

To foster interdisciplinary research, institutions within the university should adopt a flexible structure with close contacts and a good communication should exist between departments and disciplines.

Two ways of fostering interdisciplinary research are:

i. establishing research institutes or labs in which researchers from two or more university departments or disciplines tackle related problems, and
ii. linking researchers and institutes from different disciplines via networks to enhance communication and guide research in new interdisciplinary fields. Training programmes should also be highly multidisciplinary in outlook so that researchers have a flexible range of skills and can make new connections between different fields.

It should be made easy to get degrees in interdisciplinary areas without having to fulfill all the degree requirements of the two (or more) disciplines involved. Various optics could be adopted here, namely:

i. To opt for a full MSc inter-disciplinary degree elapsing various faculty disciplines ii) to embark on second/third "condensed" graduate studies.

The recognition of such a "Super MSc Degree" would strongly motivate students to challenge a second/third different subject. The industry will be quite keen to hire graduates who have mastered the challenge to study different fields with success and who will also be able to perform transdisciplinary work and research.

2.2. Roadmap(s) for Inter/Trans disciplinary Universities of the Future: "The inter/trans disciplinarity Challenge".

For University Leaders:

- Recognize that teaching (a key-role) is largely for students who will not become future academics, and for careers that don't exist yet,
- Recognize that research and teaching must be linked so that students will be ready for new ideas of knowledge that research will provide,
- Recognize that research changes very rapidly. It is therefore wise to keep teaching in very slowly changing departments and have research institutes into which it is easy to bring people from various departments for the span of a project or suits of projects.

For Funding Agencies:

First, diversity of funding is needed at all levels, since the challenges facing interdisciplinary science are so diverse. Those who devise the funding scenarios and detailed methods are far too out of touch with the people who actually do creative science.

The secret to a successful model is that there is NO best model. Many good books on military strategy give good advice. After all, the military must take decisions in very complex and time-dependent situations.

Successful models depend on responding to what is available, and especially

- rewarding and encouraging success (success means success, not just visibility)
- management not getting in the way.

Management can get in the way in an infinite variety of manners, including ones that are well-intentioned. Examples are:

- letting scientists believe they are essential without asking scientists to justify this,
- putting irrelevant social extras into funding,
- believing that one project selection approach is "best" for all sorts of projects (diversity is far better).

A point to stress is the following: The book you pick-up on management at the airport may be fine in the way it deals with problems citing few case studies, but it is better not to entirely believe it and apply it with enthusiasm. There are so many case histories of disasters following simplistic beliefs:

Inter/Transdisciplinarity is typically an EU matter as strong arguments are necessary to break the tradition at the provinciality of the University in many EU Countries. New Departments should be promoted based on Scientific Problem Solving, where the members come from different traditional areas and are compatibilized by the common interest in a modern interdisciplinary research field. Resources should then be allocated to universities on the basis of the presence in these new situations and not simply on the number of students without regard to quality.

Universities needs to be restructured: "the life in an ivory tower belongs to the past!" The rigid faculty structures need to be dismantled with the creation of small- and medium sized clusters for education and university centres for research.

One cannot expect that all students will be—in the next 5 to 10 years—, either for physical or intellectual reasons, not be mobile enough to accommodate to the ideal inter-trans disciplinary modern university model; so, transitional measures and grading systems in the inter-trans disciplinary model need to be developed.

The creation of the inter/transdisciplinary modern university of the future is a great challenge but demands a great stimuli from governments, the industry and the society. A plea is made for intra-university openness so that a coherent interdisciplinary approach within the university can be realized.

To reap the rewards of an interdisciplinary approach, universities and research institutes need to encourage a more flexible movement between disciplines by

a. breaking down rigid administrative structures,
b. setting up multidisciplinary groups or research centres/laboratories.

National governments and funding agencies should also encourage interdisciplinary activities.

It is important to encourage greater exchange of students and scientists between disciplines. One way of achieving this is by ensuring that economic and administrative barriers do not prevent movement of scientists from one discipline or country to another. In Europe, this would be aided by standardised qualification recognition procedures, European-wide training courses, and official exchange programmes. An interdisciplinary culture must also be implanted through educational (universities, research institutes) and budgetary (funding agencies, national governments, European Commission) initiatives. It must also be realised that the heterogeneity of European culture is an asset with the potential to provide imaginative ideas and diverse skills, and must be more efficiently utilised in the future.

2.3. Interdisciplinary research strategies for European Universities

The important action is to create a diverse range of funding sources for university research, not to force some grandiose, well-intentioned initiatives (Mammoth network models are a disgrace and it is not hard to see why they have failed to deliver).

i. It is unhealthy to have one big body, rather than diversity of funding. The route to deciding how funds are used is very important. It is never enough to trust that a budget, a distinguished figurehead, and peer review will lead to a golden future for research. It is also true that political constraints are harmful to effectiveness.
ii. Any proposed solution should recognize the range of types of project (not just content) that may need funding. Some sources fund overheads and others do not; sometimes, all that is needed is a way for imaginative people to try out cheaply some original ideas that would never get past the average (highly conservative) grant-awarding committee.
iii. Diversity should be an integral part of any research initiative.

The allocation of resources in a selective way through a real politically independent board is very important. Also instruments favoring interdisciplinarity and cooperation with industry are necessary. If this is not done quickly, efficiently and with transparency, the University risks producing no useful graduates and literature instead of useful scientific results.

"Bio-medical info-physics engineering" may become in 5 to 10 years a separate discipline: the training is not available today and even not possible due to the inter-faculty rules etc. Such inter-trans disciplinary education within the university urgently needs to be issued by decree, in order to pave the way for a crosswise education in a smooth and prompt way. It certainly will demand discipline from the professors and the students to deal properly with the "NEW" freedoms! In order to avoid: i) random course shopping with

a loss of the intellectual route by students and ii) the confrontation of professors with students' profiles, a structuring mechanism needs to be installed.

The industry, the government, the services sector etc. will limit, in the future, recruitment of broad-minded candidates! And young persons without the value may have difficulty finding a good job or soon become victims of unemployment.

The growing fields of nanotechnology, bio-intelligent materials, biomimetics etc. will not prosper without intensive crossover and interaction between disciplines.

This millennium will see us enter an era of novelties in medicine, transport, society… With new tools, new insights and understanding, and a developing convergence of the disciplines of physics, chemistry, materials science, biology and computing, we may dare to dream of novel and superior products and systems that were, until the 21st Century, the stuff of science fiction. This will not be possible without collaborative links between disciplines.

3. Technology Transfer between Academia and Industry based on Inter/Transdisciplinary principles

3.1. Driving Forces/Need for the Transfer of Technology – from Academia to Industry

Industry has a lot to offer, especially if projects are reviewed as they run. How soon can one tell if the project is an obvious failure and, if so, can it be diverted or stopped? Academic funding differs from industrial research in that even failed projects can be good training, and the funding is usually short term (say 3 years). The structure of any initiatives should not force a divide between industry and academia. Scientists from any sector should be free to apply for research funds, provided the work is peer-reviewable and publishable, and overheads provided (if any) are the same for each sector. It would be wrong to feel that industry steers clear of basic research.

Technology transfer has become a new "buzz word" in the academic world. Everywhere in Europe, research institutions within universities look at their American counterparts with envy or respect. The entrepreneur mindset exists in European universities; it will certainly take years, maybe decades before we catch up with the US. Europe is far behind in royalty generation. Many universities in Europe do not have and even do not wish to have technology transfer offices.

Which researcher would not be satisfied to see the results of his research used for the well-being of the society? If the goals of research are first to explore new frontiers, it has become clear that its industrial applications have recently contributed as much to the fame of the inventors. And when they become founders of successful start-ups, these inventors are sometimes more famous than Nobel Prize winners in their university.

It does not mean that every person in academia should try to create a company, the academic entrepreneur is a very rare species and it should remain so.

In future business, it will become crucial to always be innovative. It is, therefore, essential to promote collaborative research between universities and industry. It is important to bring together active scientists from academia and technologists from industry.

To be excellent and competitive on an international scale the "European University" and the "European Industry" must work together in research to develop innovations and discoveries. A guideline for universities to collaborate in research with industry is 50% of their research funds. The university research should be curiosity-discovery driven; it should not limit students' capabilities to predictable improvements of known phenomena: "Evolutionary Research" but rather to new, revolutionary "breakthrough" approaches.

The inter-trans disciplinarity aspects, together with the exchange of ideas and inspiration to innovate, will form the building blocks for the successes of the university-industry research. The synergy between university-based and industry-based research teams has been an important factor in success of US research, exemplified by the excellent "Industry-University" laboratories established by DuPont, IBM, AT&T, EXON and Corning. These laboratories have produced several Nobel Prize winners. This successful tradition has, unfortunately, never been developed in Europe.

In order to make the bridge between the University and Industry efficient and successful, it should be recognized that "University Research Centres of Excellence: Real and Virtual" should be created. The inter-trans disciplinary modern university will—in future—become the driving force of the European industry.

The conflict of curiosity-driven science and the current needs of society are as old as science itself. One needs to only recall the famous encounter between Faraday and King William IV, who once asked the celebrated scientist what his "electricity" was actually good for. Faraday answered, "One day you will tax it".

3.2. Initiatives required for a successful Knowledge Transfer.

Technology transfer is multiform.

- Start-ups have been the favourite model in recent years,

The role of inventors is vital in technology transfer. Very seldom will an established company be interested in a new technology if it cannot collaborate with the research team which developed it. A start-up will mainly be created if the inventor, either a professor or a student, is strongly involved in the creation of the company. For example, a team of university scientists move to the start-up

and further develop the technology. The professor-inventor could stay as a university professor and a scientific consultant with the company.

- Direct licensing with established companies is another way to transfer technology.

Creating a company may simply not be realistic when the technology is only a small brick in a much bigger system. Or the team may not have the entrepreneurial mindset. Licensing the technology to an established company is another option. Without the collaboration between the company and the university, the technology cannot be developed properly or very successfully

- Collaborative research with industry is another clear option

Collaborative research with industry is another rich ground for innovation and enhances the development of technologies issued from universities and their transformation into products. University should develop strong links with industry and actively promote such interactions: development of unique "real breakthroughs" by exploratory project research.

There are examples which have proven that despite a lack of size, resources and a new undiscovered market, an academic spin-off can become a leader in a niche market. The focus of the research and the ability to identify meaningful applications are important success factors.

There are, at least, two common points in any transfer: first it takes time and second it takes a high involvement of the inventors without whom a successful collaboration between the industry and the university is very unlikely.

The royalties will never be able to replace the traditional funding of research. Even the growing role of industry in the funding of research is no guarantee for the success of technology transfer. So, this new fame has to have other roots.

Future breakthroughs in technologies can only be achieved when the central role of basic science in the search for revolutionary new phenomena is recognised by governments. It is critical that new and sustainable programmes in basic science research are launched to form a reliable backbone for science networks and scientific centres of excellence.

One of the hazards of commercialising research at the university level is that the free flow of ideas and information can be hampered as scientists and financiers seek to protect their investments and gain advantages over their competitors. There can also be serious conflicts of interest when researchers' expectations of financial reward bias the interpretation, reporting or selection of experimental results. There is therefore a pressing need to untangle universities' relations with industry, and clarify both their roles in wealth creation. Basic "University Type" research is the most important investment that a company can make, both for its own future and the future of the society in which it operates.

Allowing scientists at universities to pursue curiosity-driven research free from commercial constraints is the only way to ensure a truly innovative research environment. In the long term private industry, the economy will benefit from the new ideas and discoveries that will be made. For example, many of the material breakthroughs made in the US industrial labs in the last century occurred when scientists were given budgets and freedom to pursue their own ideas, rather than following a fixed corporate strategic plan.

While the outsourcing of basic research to universities by the private sector offers substantial benefits to both sides, it is also important that industry be encouraged to establish and support their own in-house research labs. Without sufficient investment in its own basic research, the innovations necessary for the continued growth and competitiveness of a company are less likely to be forthcoming, as university departments cannot apply as concentrated an effort to a practical problem as the company itself can. The governments should therefore take rapid steps to encourage businesses to invest more in research, basic and applied, short-term and long-term, at universities and their own laboratories. Each country that does this is making a wise investment in its own future.

These suggestions are made with the aim of balancing industrial research needs with the need for "blue skies" research and teaching at universities to maintain the highest standards of academic excellence. The issues are extremely complex, and a great deal more discussion needs to be carried out between all parties involved.

The mobility of individuals between academic and industrial laboratories is especially vital in the transfer of new concepts and technology. In addition, these relations provide university researchers with an understanding of problems that are relevant to industry. Industry, university, research institute collaboration should be promoted in newly created Materials Research Centres. Commercial companies, universities, governments, research organizations and technical societies must all seek to re-define their role in this expanding partnership. There will be challenges regarding management of such a system, and for handling issues of intellectual property, but such co-operative institutes must be the way forward, benefiting companies both large and small.

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Transdisciplinary Education for Deep Learning, Creativity and Innovation

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Abstract

American Universities today offer more than 1000 specialized disciplines and subdisciplines, and their European counterparts are imitating them. The mental world we live in is infinitely divided into categories, subjects, disciplines, topics, and more and more specialized subdivisions. Our past knowledge is organized into "silos": good for grain, not for brain. Forcing societies to fit their knowledge into boxes with unrelated arbitrary boundaries, without understanding the deep reasons behind them, may lead to serious consequences, like those we witness in world affairs today. Reality is the temporal unfolding of events, and path dependence is a central concept to explain complex emergent phenomena. In modern times, specialization has overtaken broader fields of knowledge and multidisciplinary research. To overcome the missing path dependence problem, interdisciplinary and transdisciplinary education are really the ways society, together with scientists and scholars, must catch up with. Interdisciplinary education consists, for instance, of a multidisciplinary relational reformulation of problems. On the other hand, transdisciplinary education is related to the study of achieving optimal reformulations to unlock their fundamental properties. We need to recall the dawn of transdisciplinary thinking from Jean Piaget's words to achieve an effective deep learning system. Transdisciplinary education and transdisciplinarity propose the understanding of the present world by providing more unified knowledge to overcome the famous paradoxes of relative knowledge and perfect knowledge and to unfold hidden creativity and innovation. Three fundamental examples are presented and discussed in the paper.

1. Introduction

"Horror Vacui" (a Latin-derived term that means "fear of emptiness") may have had an impact, consciously or unconsciously, as "dread for empty space" on Nature to primeval man overwhelmed by an excess of emptiness, forced to live in a world not yet filled up with signs, symbols, meanings and … data.

Many eons later (today), laymen can find themselves in a "Horror Pleni" (a Latin-derived term that means "fear of stuffed space"), information overload, totally unable to discriminate the difference between optimized encoding of an information-rich message and a random jumble of signs (Fiorini, 2014). Horror Pleni is an Italian neologism coined by Italian art critic, painter, and philosopher Gillo Dorfles in the 21st century (Dorfles, 2008). Horror Vacui and Horror Pleni are two fundamental concepts referring to humans' intellectual operative range. Their deep meaning can be translated and extended to many different disciplined areas like art, literature, sociology, science, etc. As a matter of fact, our unconscious background is pervaded with ancestral, primeval, cosmic, and archetypal symbol/sign and dread in both situations. A dread that our current existential level is amplifying to higher levels of global confusion, chaos and/or abysmal isolation and deep internal silence.

The discovery of Nature as a reality prior to and in many ways escaping human purposes begins with the story of the sign. The story of the sign, in short, is of a piece within the story of philosophy itself, and begins, all unknowingly, where philosophy itself begins, though not as philosophy. Even if we do not have to explore every theme of that history, we must yet explain all those themes that pertain to the presupposition of the sign's being and activity, in order to arrive at that being and activity with sufficient intellectual tools to make full sense of it as a theme in its own right. And those themes turn out to be nothing less or other than the very themes of ontology and epistemology forged presemiotically, as we might say, in the laboratory for discovering the consequences of ideas that we call the history of philosophy (Deely, 2001, pp. 19-20). If the discovery of the sign began, as a matter of fact, unconsciously with the discovery of Nature, then the beginning of semiotics was first the beginning of philosophy, for it is philosophy that makes the foundation of semiotics possible, even if semiotics is what philosophy must eventually become (Eco, 1976). Italian semiotician Umberto Eco argued that "Iconic Language" has a "triple articulation." Iconic Figures, Semes (combinations of Iconic Figures), and Kinemorphs (combination of Semes), like in a classical movie (Stam, 2000). A semiotic code which has "double articulation" (as in the case of verbal language) can be analyzed into two abstract structural levels: a higher level called "the level of first articulation" and a lower level, "the level of second articulation" (Hjelmslev, 1961).

Quite often, from an individual perspective, external events seem to be an entirely random series of happenings. But looked at over a long period of time, and tracking the branching changes in the planet that follow from it, all chaos does produce a form of identifiable order. Patterns appear out of chaos. And this, in its essence, is chaos theory: finding order in chaos (Wheatley, 2008). Chaos theory falls into that category of scientific ideas that few actually understand but many have heard of, due to its expansive, epic-sounding principles and thoughts. Inherent to the theory is the idea that extremely small changes produce enormous effects, but ones that can only be described fully in retrospect. Why? The fundamental reason is more evident in social systems. In social systems any signal is actually small, weak, never strong. Weak signals are "the real foundation of the whole society" (Ansoff, 1975; Poli 2013). Accurate prediction is somewhat impossible and it is known that the occurrence of extreme events cannot be predicted from history (Taleb, 2015). The main reason is that even our more advanced instrumentation systems will be never accurate enough to capture the full essence of a real event. Nevertheless, novel entropy minimization techniques can improve our traditional knowledge capturing capability from experience in terms of many orders of magnitude, according to the brand new CICT (Computational Information Conservation Theory) (Fiorini & Laguteta, 2013; Fiorini, 2014, 2015, 2016; Wang et al., 2016).

Mankind's best conceivable worldview is at most a representation, a partial picture of the real world, an interpretation centered on man. We inevitably see the universe from a human point of view and communicate in terms shaped by the exigencies of human life in a natural uncertain environment. What is difficult is processing the highly conditioned sensory information that comes in through the lens of an eye, through the eardrum, or through the skin. In fact, at each instant, a human being receives enormous volumes of data, and we have a finite number of brain cells to manage all the data we receive quickly enough.

According to current theories, brain researchers estimate that the human mind takes in 11 million pieces (tokens) of information per second through our five senses but is consciously aware of only 40 of them (Koch et al., 2006; Wilson, 2004; Zimmermann, 1986). Hence, our neuro interfaces and our brain have to filter information to the extreme. To better clarify the computational paradigm, we can refer to the following principle: "Animals and humans use their finite brains to comprehend and adapt to an infinitely complex environment" (Freeman & Kozma, 2009). We are constantly reconstructing the world's essential and superficial characteristics. This is the outcome of the on-going evolution of our relationships in a world full of surprises and challenges (Espejo & Reyes, 2011) related to deeper characteristics.

"Consilience" is the term coined by William Whewell in 1840 (Whewell, 1840) and later used by Edward O. Wilson (Wilson, 1998) for the integration of knowledge that involves a continuous remapping of reality. A constant shift of conceptual frames. Improving the consilience between disciplines of knowledge is a worthwhile philosophical aim. Arguably, it makes reality more coherent. Because of consilience, the strength of evidence for any particular conclusion is related to how many independent methods are supporting the conclusion, as well as how different these methods are. Those techniques with the fewest (or no) shared characteristics provide the strongest consilience and result in the strongest conclusions. This also means that confidence is usually the strongest when we consider evidence from different fields, because the techniques are usually very different.

In modern times, specialization has overtaken broader fields of knowledge and multidisciplinary research. The mental world we live in today is infinitely divided into categories, subjects, disciplines, topics, and more and more specialized subdivisions. Our past knowledge is organized into "silos": good for grain, not for brain. Therefore, their consilience is quite poor. Nevertheless, American universities now offer more than 1000 specialized subdisciplines, and their European counterparts are following them. Forcing societies to fit their knowledge into boxes with unrelated arbitrary boundaries, without understanding the deep reasons behind them, may lead to serious consequences, like those we witness in world affairs today. Why are there so many different disciplines? In the next section we open the door to the root of this problem.

2. Fundamental Physics: Roots, Multidisciplinary and Interdisciplinary Education

Over the centuries, the human worldview about our spacetime universe has been shifting into many evolving scientific paradigms or shared conceptual systems in an accelerating pace. A conceptual system is an integrated system of concepts that supports a coherent vision of some aspect of the world (Byers, 2015). We found more than twenty proposed and renowned worldview interpretations in the past scientific literature and grouped them into nine major conceptual disciplined areas (Figure 1).

Figure 1. More than twenty proposed and renowned worldview interpretations in scientific literature, grouped into nine major conceptual disciplined areas (see text).

- **1- Naturalistic DaVincian (1478): sxt.**
- **2- Relativistic Galileinian (1632): t ≡ A; s ≡ R.**
- **3- Reductionist Positivist (1687): t ≡ A; s ≡ A.**
- **4- Relativistic Einsteinian (1921): sxt.**
- **5- Quantum Stochastic (1924–1927): E(f(sxt)). (The Copenhagen Interpretation: Niels Bohr, Werner Heisenberg and Paul Dirac.)**
- **6- Quantum Causal (1950-1992): sxt (Open System). (The de Broglie–Bohm theory Interpretation: Louis de Broglie, David Bohm.)**
- **7- Quantum Relational (1994-1997): (Open Systems). (The RQM Interpretation: Carlo Rovelli, Basvan Fraassen and by Michel Bitbol.)**
- **8- Quantum Transactional (1986-2013): (Open Systems). (TIQM: John G. Cramer, R. Kastner.)**
- **9- Quantum Bayesian (2002-2013): (Open Systems). (QBT: Carlton Caves, Fuchs and Schack.)**

We start with the da Vincian approach that considered our spacetime universe as an indissoluble unity to arrive at the Galilean approach where spacetime was split into absolute time and relative space. Then the Reductionist Positivist approach by Newton which considered absolute time as completely separated from absolute space, till the advent of the Relativistic Einsteinian approach which rejoined absolute time and absolute space into an indissoluble unity called spacetime.

In the same decade the Quantum Stochastic approach was discovered, propelled by Niels Bohr, Werner Heisenberg, Paul Dirac and the Copenhagen School in the 1920s, where a probabilistic estimation formula for spacetime functions was adopted (Schroedinger's equation). This step of development culminated with the construction of the theory of quantum electrodynamics (QED) in the 1950s. The door to new quantum mechanics theories were now open. In the mid-1970s upon experimental confirmation of the existence of quarks, the Standard Model (STM) of elementary particle physics was developed. The STM distinguishes between fundamental and accidental symmetries. The distinction is not based on empirical features of the symmetry, nor on a metaphysical notion of necessity. A symmetry is fundamental to the extent that other aspects of nature depend on it, and it is recognized as fundamental by its being theoretically well-connected within the theoretical description of nature, that is, by its theoretical rigidity. Symmetrical properties affect world level structures and properties in an analogous way to phoneme level and syllable level properties create "double articulation" in human language (Hockett, 1958, 1960).

There is a very general point about the analysis of scientific knowledge in this. In any particular case of analysis of a symmetry (an explanation, a law), the answer to the question, "What makes this a fundamental symmetry (a genuine explanation, a law and not just an accidental regularity)?" is long and tangled, showing the pervasive dependence of other features of nature on this one. If such a long and tangled answer cannot be found, then there is no reason to think that this is a fundamental symmetry (an explanation, a law), because the entanglement is really all there is to being fundamental (an explanation, a law). This interconnectedness is part of the essential nature of science (Kosso, 2000).

Although the STM is believed to be theoretically self-consistent and has demonstrated huge and continued successes in providing experimental predictions, it does leave some phenomena unexplained and it falls short of being a complete theory of fundamental interactions. It does not incorporate the full theory of gravitation as described by general relativity, or account for the accelerating expansion of the universe (as possibly described by dark energy). The model does not contain any viable dark matter particle that possesses all of the required properties deduced from observational cosmology. It also does not incorporate neutrino oscillations (and their non-zero masses) either.

The STM model of particle physics covers the electromagnetic, the weak and the strong interaction. However, the fourth fundamental force in nature, gravitation, has defied quantization so far. Although numerous attempts have been made in the last 80 years, and in particular very recently, there is no commonly accepted solution up to the present day. One basic problem is that the mass, length and time scales quantum gravity theories are dealing with are so extremely small that it is almost impossible to test the different proposals, even with the current, most advanced instrumentation resources.

The development of the STM was driven by theoretical and experimental particle physicists alike. For theorists, the STM is a paradigm of quantum field theory (QFT), which exhibits a wide range of physics including spontaneous symmetry breaking, anomalies, non-perturbative behavior, etc. It is used as a basis for building more exotic models that incorporate hypothetical particles, extra dimensions, and elaborate symmetries (such as supersymmetry) in an attempt to explain experimental results at variance with the STM, such as the existence of dark matter and neutrino oscillations.

Since the second half of 1970s many research groups tried to promote their interpretations of the quantum world. Other approaches to resolve conceptual problems introduced new mathematical formalism, and so proposed additional theories with their interpretations. An example is the "Quantum Causal" approach or "Bohmian mechanics," which is empirically equivalent with the standard formalisms, but requires extra equations to describe the precise trajectory through state space taken by the actual world. This extra ontological cost provides the explanatory benefit of explaining how the probabilities observed in measurements can arise somewhat naturally from a deterministic process.

Since the 1990s, there has been a resurgence of interest in "non-collapse theories." The Stanford Encyclopedia, as of 2017 (IQM, 2017), groups interpretations of quantum mechanics into five areas: "Bohmian mechanics" (pilot-wave theories) (Goldstein, 2013), "collapse theories" (Ghirardi, 2011), "many-worlds interpretations" (Vaidman, 2015), "modal interpretation" (Lombardi & Dieks, 2014), and "relational interpretations" (Laudisa & Rovelli, 2013), as classes into which most suggestions may be grouped.

The most common interpretations of quantum mechanics are listed as a tabular comparison in Wikipedia (IQM, 2017). The attribution values shown in the cells of that table are not without controversy, for the precise meanings of some of the concepts involved are unclear and, in fact, are themselves at the center of the controversy surrounding the given interpretation in the scientific community. No empirical evidence exists that distinguishes among these interpretations. To that extent, the physical theory stands, and is consistent within itself and with observation and experiment; difficulties arise only when one attempts to "interpret" the theory.

Nevertheless, designing experiments which would test the various interpretations are and will be the subject of active research in the next few years. Most of these interpretations have variants. For example, it is difficult to get a precise definition of the original "Copenhagen interpretation" as it was developed and argued about by many people. Interpretations of quantum mechanics attempt to provide a conceptual framework for understanding its many aspects which are not easily handled by the conceptual framework used for classical physics (Science 1.0).

At present, the most important extant versions of quantum gravity (Weinstein & Rickles, 2015) theories are canonical quantum gravity, loop theory and string theory. Canonical quantum gravity approaches leave the basic structure of QFT untouched and *just* extend the realm of QFT by quantizing gravity. Other approaches try to reconcile quantum theory and general relativity theory not by supplementing the reach of QFT but rather by changing QFT itself. String theory, for instance, proposes a completely new view

concerning the most fundamental building blocks: It does not merely incorporate gravitation but it formulates a new theory that describes all four interactions in a unified way, in terms of strings (Kuhlmann, 2012).

It is not so difficult to see why gravitation is far more difficult to deal with than the other three forces. Electromagnetic, weak and strong forces all act in a given space-time. In contrast, gravitation is, according to GRT (General Relativity Theory), not an interaction that takes place in time, but gravitational forces are identified with the curvature of spacetime itself. This viewpoint that gravity is not a physical interaction allows what are classically regarded as gravitational forces to be consistent with the relativistic principle of causality (that no interaction can travel faster than the speed of light), and it leads to the possibility of an infinite universe, our own observable universe being limited to the part that is receding from us at "observed" speeds less than the velocity of light. Thus quantizing gravitation could amount to quantizing spacetime, and it is not at all clear what that could mean. One controversial proposal is to deprive spacetime of its fundamental status by showing how it "emerges" in some non-spatio-temporal theory. The "emergence" of spacetime then means that there are certain derived terms in the new theory that have some formal features commonly associated with spacetime.

The most recent, sound proposal for one fundamental solution to quantum gravity is under evaluation in the scientific community. According to José Vargas, the Kähler equation, which is based on Cartan's exterior calculus and which generalizes the Dirac equation, solves the fine structure of the hydrogen atom without gamma matrices. A Kaluza-Klein (KK) space results, where geometry and general relativity meet quantum mechanics. Gravitation and quantum mechanics are thus unified *ab initio*, while preserving their respective identities. Weak and strong interactions, and also classical mechanics, start to emerge. Each does so, however, in its own idiosyncratic way. All physical concepts are to be viewed as emergent. Emergence of this type and reductionism are as inseparable as the two faces of an ordinary surface (Vargas, 2014).

In general, any interpretation of quantum mechanics is a conceptual or argumentative way of relating between:

- The "formalism" of quantum mechanics (mathematical objects, relations, and conceptual principles that are intended to be interpreted as representing quantum physical objects and processes of interest), and
- The "phenomenology" of quantum physics (observations made in empirical investigations of those quantum physical objects and processes, and the physical meaning of the phenomena, in terms of ordinary understanding).

Two qualities vary among interpretations, according to hermeneutics:

- *Ontology (it claims about what things, such as categories and entities, "exist" (reality) in the world, and what theoretical objects are related to those real existents)*;
- Epistemology (it claims about the possibility, scope, and means toward relevant "knowledge" of the world).

In the Philosophy of Science (Epistemology), the distinction of knowledge versus reality is termed "epistemic" versus "ontic". A general law is a regularity of outcomes (epistemic), whereas a causal mechanism may regulate the outcomes (ontic). A phenomenon can receive interpretation either in an ontic or epistemic manner. For instance, indeterminism may be attributed to limitations of human observation and perception (epistemic), or may be explained as a real existent maybe encoded in the universe (ontic). Confusing the epistemic with the ontic, like if one were to presume that a general law actually "governs" outcomes, and that the statement of a regularity has the role of a causal mechanism, is a category mistake.

In a broad sense, scientific theory can be viewed as offering scientific realism, an approximately true description or explanation of the natural world, or might be perceived with antirealism. A realist stance seeks the epistemic and the ontic, whereas an antirealist stance seeks epistemic but not the ontic. In the 20th century's first half, antirealism was mainly logical positivism, which sought to exclude unobservable aspects of reality from scientific theory. Since the 1950s, antirealism has become more modest, which concerns mostly instrumentalism, permitting talk of unobservable aspects, but ultimately discarding the very question of realism and posing scientific theory as a tool to help humans make predictions, not to attain metaphysical understanding of the world. The instrumentalist view can best be explained by the famous quote of David Mermin, "Shut up and calculate", often misattributed to Richard Feynman.

Our current worldview supports a universe that progressively expands in time and generates unprecedented levels of complexity, evolving as an emergent process which is creative and not as a replay of pre-established models, not as the projection onto time of a timeless set of Platonic models and mathematical ideas. American theoretical physicist John A. Wheeler, a major theorist of the "participatory anthropic principle" (PAP) (PAP, 2017), formulates a similar principle from the point of view of quantum physics:

"we used to think that the electron in the atom had a position and a velocity regardless of whether we measure it or not….",

but the observer's position has to be taken into account, and here quantum theory ties in with George Berkeley's metaphysics of observation.

Therefore, for a multidisciplinary education, we can start from our nine major conceptual disciplined areas (Figure 1) and group them further into three fundamental reference paradigm areas: the Positivist (Newtonian), the Relativist (Einsteinian) and the Constructivist (Quantum) conceptual framework (CF). These three fundamental CFs or reference paradigm areas constitute just the

minimal elementary knowledge to build a strong and reliable multidisciplinary competence, from which an intercultural competence can be grown. But we must still be aware of the mistake.

Paradigmatic or shared conceptual system confusion occurs when incompatible epistemological assumptions are inadvertently mixed with explanations and practice. This last phenomenon is particularly troublesome for interdisciplinary and intercultural relations, because a disciplinary field relies on "theory into practice" as its criterion for conceptual relevance. If the paradigm underlying a practice is different from the explanation attached to the practice, both the credibility of the concept and the effectiveness of the method suffer.

According to Wilson, the ultimate goal of our epistemological activities is a single complete theory of everything, and the foundation of this theory must be the sciences. Although each discipline seeks knowledge according to its own methods, Wilson asserts that "the only way either to establish or refute consilience is by methods developed in the natural sciences." The end of this process would realize a dream that goes back to Thales of Miletus, the sixth-century B.C. thinker whom Wilson credits with founding the physical sciences.

Modern philosophy was initiated through a rupture from earlier thought, e.g., Bacon's smashing of the idols, Locke's imagining the mind as a blank tablet, and Descartes' systematic doubt. This created an empty space reserved exclusively for clear and distinct ideas joined with the rigorously deductive process of "objective" thinking essential to science. More recently questions have been raised regarding, not the fruitfulness, but the adequacy of this mode of thinking. Great efforts are now being taken to broaden this field of knowledge to include human subjectivity and other modes of awareness as deep thinking, meditative thinking, creative imagination and phenomenological investigation. The contrast between the uncertainty of the future and the fixity of the past is, despite some postmodernist strictures, a basic presupposition in our everyday experience of time: it provides, actually, much of the ground for an ontological distinction between the future and the past. Hence, philosophy is expanding to include hermeneutic recognition, interpretation and relation between the multiple values, cultures and civilizations of the many peoples of the world and their varied modes of understanding. Philosophers now are challenged to unveil at a deeper level the cumulative freedom by which we shape ourselves with the subjective terms of values and virtues, which in turn constitute cultures and their traditions. These constitute the hermeneutic vantage points or horizons in terms of which we understand, interpret and respond in the many dimensions of our life.

There are many obstacles to Wilson's program of unifying knowledge. The greatest involves finding a place for the normative in the theory of everything. Much of what goes on in moral philosophy, literature, the arts, and the human sciences-disciplines that Wilson would like to dispense with in their present form is directed toward telling us how to live rather than how the world is. As long as we remain creatures who act as well as think and who moralize as well as conceptualize, it is hard to see how our system of knowledge can be unified in the way that Wilson wishes.

At a more practical level, we, the children of the Anthropocene Era, are entering the 4th industrial revolution and the impact is going to be pervasive and of greater magnitude compared to the previous industrial revolutions. The incoming changes, which are approaching at an accelerating speed, will be impacting everything and everybody and blurring the lines between the physical, digital, and biological spheres; they will affect the bio-psycho-social dimensions, our narratives and even what it means to be human. Narrative is a major cognitive instrument to deal both with the irrevocability of the past and with the contingency of future events, dealing at its core with a retrospective perspective on events which used to be future or contingent, but have since become past and irrevocable. Narrative is, more specifically, a way to handle the human time of action, experience, and social relationships. Therefore, narrative is an emergent phenomenon which turns back on the evolutionary nature of cosmic reality itself. If we are not farsighted and do not plan effectively, the results could be very problematic for all life forms on Earth. If we manage the 4th industrial revolution with the same blindness and forms of denial with which we managed the previous industrial revolutions, the negative effects will be exponential (Zucconi, 2016). At the social level, inequality and unemployment destroy opportunity freedom. Radical inequality significantly undermines opportunity freedoms and capacity freedoms and consequently radically undermines human capital as a foundation of community prosperity (Nagan, 2016).

As the global age brings new possibilities and challenges, we need to think in much broader terms than ever before. Where in the past ethics narrative could be grounded in relatively restricted calculi of good and evil, according to the specific character of the persons, substances or natures involved, now we find that small actions have global effects and that these are filtered through a massive array of cultures. Narrative models the limited openness of the past through selectivity and perspectivism, and therefore stands at the no-man's land between the irrevocability of the past and the emergence of "new pasts." Time, understood as the conscious time experienced by brains, and not merely as the unconscious time of sentient life, has complexified reality into a new dimension: the virtual reality of experience mediated by memory, by anticipations, by expectations. It is time made conscious through representations. Therefore, brains can be conceived as a virtual reality machine, a narrative machine, and a harmonization machine. The brain manages an organism's response to stimuli, including decisions resulting from the sum and the relative weight of stimuli. A more elaborate brain anticipates possible responses, creates scenarios and models possible realities depending on the outcome of choices. It also requires, however, a critical perspective on the potential fallacies which accompany narrative explanations, notably hindsight bias. This is the main reason why we need reliable and effective training tools to achieve full narrative and predicative proficiency, such as the EPM (De Giacomo, 1993) and EEPM (Fiorini, 2017a).

Hence, to ethics there needs to be an added aesthetic narrative dimension, so that human beings and societies are truly mobilized to bring together their distinctive gifts in order to work toward a global world marked by equity and balance, harmony and peace.

Human culture can intensify this virtualization of the environment, and human beings can inhabit the ultimate virtual reality game, a multidimensional space of cultural representations and semiotic objects which includes, finally and literally, actual narratives and virtual reality devices. Reality as we face it is a vast web of related phenomena, each of which appears to be supervenient, or "just-so", the result of a contingent facticity inherent to the complex structure of the universe itself.

Interdisciplinary and transdisciplinary education systems are really the ways society, together with scientists and scholars, must move on to. Interdisciplinary education consists, for instance, of a multidisciplinary relational reformulation of problems, like from theoretical to practical representations, from mechanical to electromagnetic, from chemical to biological, from clinical research to healthcare, etc. On the other hand, transdisciplinary education is related to the study of achieving their optimal reformulations and their interrelated fundamental properties. We need to recall the dawn of transdisciplinary thinking from Jean Piaget's words (Piaget, 1972a, p.138):

> *"...higher stage succeeding interdisciplinary relationships... which would not only cover interactions or reciprocities between specialised research projects, but would place these relationships within a total system without any firm boundaries between disciplines."*

3. Transdisciplinary Education

In the past century, in their questioning of the foundations of science, Edmund Husserl (Husserl, 1966) and other scholars discovered the existence of different levels of perception of Reality by the subject-observer. But these thinkers, pioneers in the exploration of a multi-dimensional and multi-referential reality, have been marginalized by academic philosophers and misunderstood by a majority of physicists, who are cocooned in their respective specializations.

Werner Heisenberg came very near, in his philosophical writings, to the concept of "level of Reality". In his famous manuscript of the year 1942 (published only in 1984) (Heisenberg, 1984), Heisenberg, who knew Husserl well, introduces the idea of three regions of reality, and was able to give access to the conception of "reality" itself. The first region is that of classical physics, the second that of quantum physics, biology and psychic phenomena and the third that of the religious, philosophical and artistic experiences. This classification has a subtle ground: the closer and closer connectedness between the Subject and the Object.

As a matter of fact, ontology, in its philosophical meaning, is the discipline investigating the structure of reality. Its findings can be relevant to knowledge organization, and models of knowledge can, in turn, offer relevant ontological suggestions. Several philosophers in time have pointed out that reality is structured into a series of integrative levels, like the physical, the biological, the mental, and the cultural, and that each level acts as a base for the emergence of more complex levels. More detailed theories of levels have been developed by Nicolai Hartmann (Hartmann, 1942) and James K. Feibleman (Feibleman, 1954), and these have been considered as a source for structuring principles even in bibliographic classification by both the Classification Research Group (CRG, 1969) and German information scientist and philosopher Ingetraut Dahlberg's (Dahlberg, 1978) ICC (Information Coding Classification) (ICC, 2017).

CRG's analysis of levels and of their possible application to a new general classification scheme based on phenomena instead of disciplines, as it was formulated by Derek Austin in 1969 (Austin, 1969), has been examined in detail by Gnoli & Poli (2004). The analyses by Feibleman and Austin refer to a level either as the whole or as a part. However, it is worth mentioning that the theory of levels has been studied by most of the scholars, who have elaborated its details, as a way to improve both the (traditional) theory of being and the theory of wholes. The interpretation of "level" as either the whole or a part runs into serious troubles as soon as psychological and social factors are taken into account. On the other hand, Dahlberg highlights the search for objective criteria of classification of the content of documents, making them more adherent to knowledge as they are developed by science: e.g., the structure of a classification should be based on levels, because reality itself has a levelled structure. ICC's conceptualization goes beyond the scope of the well-known library classification systems, such as Dewey Decimal Classification (DCC), Universal Decimal Classification (UDC), and Library of Congress Classification (LCC), by extending also to knowledge systems that so far have not tried to classify literature. ICC actually presents a flexible universal ordering system for both literature and other kinds of information, set out as knowledge fields (Dahlberg, 2012).

Furthermore, it is important not to confuse ontological problems with those involved in their formal translation. In other words, care must be taken to distinguish between the ontological tree and the logical tree that should be its rigorous translation. Logic can be distinguished from formal ontology, but only in the sense of logic as uninterpreted calculus. The method for constructing abstract formal systems is subject to varying interpretations over varying domains. Above all, we must consider the fact that the definitive differentiation of the fundamental forms of words (noun and verb) in the Greek form of "onoma" and "rhema" was worked out and first established in the most immediate and intimate connection with the conception and interpretation of Being that has been definitive for the entire Western world. This inner bond between these two happenings is accessible to us unimpaired and is explored out in full clarity in Plato's *Sophist*.

In fact, the levels of Reality are radically different from the levels of the representation of system organization as these have been defined in recent systemic approaches (Nicolescu, 1992). Levels of organization do not presuppose a break with fundamental concepts: several levels of organization appear at one and the same level of Reality. The levels of organization correspond to different structuring of the same fundamental laws. For example, Marxist economy and classical physics belong to one and the same level of Reality.

Since the definitive formulation of quantum mechanics around 1930, founders of the new science have been acutely aware of the problem of formulating a new "quantum logic." Subsequent to the work of George Birkhoff and John von Neumann, a veritable flourishing of quantum logic was not far from its arrival (Brody, 1984). The aim of this new logic was to resolve the paradoxes which quantum mechanics had created and to provide a conceptual framework for understanding the many aspects of quantum mechanics which are not easily handled by the conceptual framework used for classical physics. All that in the attempt, to the extent possible, to arrive at a predictive power stronger than that afforded by classical logic.

History will credit Stéphane Lupasco for having shown that the logic of the "included middle" is a true logic, formalizable and formalized, multivalent (with three values: A, ¬A (non-A), and T) and non-contradictory (Lupasco, 1987). His philosophy, which takes quantum physics as its point of departure, has been marginalized by physicists and philosophers. Curiously, on the other hand, it has had a powerful albeit underground influence among psychologists, sociologists, artists, and historians of religions.

Perhaps the absence of the notion of "levels of Reality" in his philosophy obscured its substance: many persons wrongly believed that Lupasco's logic violated the principle of non-contradiction. Our understanding of the axiom of the included middle (i.e. there exists a third term T which is at the same time A and ¬A) is completely clarified once the notion of "levels of Reality" is introduced.

In order to obtain a clear image of the meaning of the included middle, we can represent the three terms of the new logic (A, ¬A, and T) and the dynamics associated with them by a triangle in which one of the vertices is situated at a finer level of Reality and the two other vertices at another level of Reality. If one remains at a single level of Reality, all manifestation appears as a struggle between two contradictory elements (e.g. wave A and corpuscle ¬A). The third dynamic, that of the T-state, is exercised at another level of Reality, where that which appears to be disunited (wave or corpuscle) is in fact united (quantum), and that which appears contradictory is perceived as non-contradictory. It is the projection of T on one and the same level of Reality which produces the appearance of mutually exclusive, antagonistic pairs (A and ¬A). A single level of Reality can only create antagonistic oppositions. It is inherently self-destructive if it is completely separated from all the other levels of Reality. A third term, let us call it T_0, which is situated on the same level of Reality as that of the opposites A and ¬A, cannot accomplish their reconciliation.

The T-term is the key in understanding indeterminacy: being situated on a different level of Reality than A and ¬A. It necessarily induces an influence of its own level of Reality upon its neighboring and different level of Reality: the laws of a given level are not self-sufficient to describe the phenomena occurring at the respective level.

The entire difference between a triad of the included middle and a Hegelian triad is clarified by consideration of the role of time. In a triad of the included middle the three terms coexist at the same moment in time. On the contrary, each of the three terms of the Hegelian triad succeeds the former in time. This is why the Hegelian triad is incapable of accomplishing the reconciliation of opposites, whereas the triad of the included middle is capable of it. In the logic of the included middle the opposites are rather contradictories: the tension between contradictories builds a unity which includes and goes beyond the sum of the two terms. The Hegelian triad would never explain the nature of indeterminacy.

One also sees the great dangers of misunderstanding engendered by the common enough confusion created between the axiom of the excluded middle and the axiom of non-contradiction. The logic of the included middle is non-contradictory in the sense that the axiom of non-contradiction is thoroughly respected, a condition which enlarges the notions of "true" and "false" in such a way that the rules of logical implication no longer concern two terms (A and ¬A) but three terms (A, ¬A and T), co-existing at the same moment in time. This is a formal logic, just as any other formal logic: its rules are derived by means of a relatively simple mathematical formalism. The logic of the included middle does not abolish the logic of the excluded middle: it only constrains its sphere of validity.

The logic of the excluded middle is certainly valid for relatively simple situations. On the contrary, the logic of the excluded middle is harmful in complex, transdisciplinary cases. The term "transdisciplinary," carrying a different meaning from "interdisciplinary," was first introduced in 1970 by Jean Piaget (Piaget, 1972b). From etymological point of view "trans" means "between, across, beyond." Basarab Nicolescu means by the term "transdisciplinary" that "which deals with what is at the same time between disciplines, through disciplines and beyond any discipline" (Nicolescu, 1996). Therefore, "transdisciplinarity" is clearly not a new discipline but a new human worldview. See also the Internet site of the International Center for Transdisciplinary Research (CIRET) (CIRET, 2015). In this way, one can see why the logic of the included middle is not simply a metaphor, like some kind of arbitrary ornament for classical logic, which would permit adventurous incursions into the domain of complexity. The logic of the included middle is the privileged logic of complexity, privileged in the sense that it allows us to cross and to navigate the different areas of knowledge in a coherent way, by enabling a new kind of simplicity.

Applied to education, transdisciplinarity is an essential step in the formation and becoming of man in the facilitation of his access and participation in the socio-cultural and spiritual life. The current living generation is experiencing a transition from history to hyperhistory. Advanced information societies are more and more heavily dependent on ICTs (Information and Communication Technologies) for their normal functioning and growth. Processing power will increase, while becoming cheaper and cheaper. The amount of data will reach unthinkable quantities. And the value of our networked resources will grow almost vertically. However, our storage capacity (space) and the speed of our communications (time) are still lagging behind. Hyperhistory is a new era in human development, but it does not transcend the spacetemporal constraints that have always regulated our life on this planet. The question to be addressed next is: "given all the variables we know, what sort of hyperhistorical environment are we building for ourselves and for future generations?" The short answer is: the "Infosphere." For the long answer, see Floridi (2014). The acquisition

of information specific to a domain of knowledge needs to be made with the idea of maintaining the completeness of knowledge through the interaction with other fields of knowledge. These relationships and interrelationships actually express the unity of the studied phenomenon as part of reality.

Transdisciplinary education and transdisciplinarity propose an understanding of the present world by providing more unified knowledge to overcome the famous paradox of relative knowledge, according to which the sphere of knowledge increases in arithmetic progression while the area of ignorance increases in geometric progression, thus solving a problem at the cost of acquisition of two, etc. The solution that we propose is another paradox, much less known, that of perfect knowledge, according to which only when we understand the reasons why we cannot achieve real knowledge, it becomes accessible to us. In other words, understanding why we cannot understand, we begin to understand! It is the same apparent paradox we have in current computer computation as underlined by CICT, where computation can use either an "approximated approximation" or "exact approximation" representation system. To achieve an exact approximation computational number representation, logic must be described in terms of "self-closure spaces" to avoid the contemporary IDB (Information Double Bind) problem (Fiorini, 2014, 2017b). Reality is the temporal unfolding of events, and path dependence is a central concept to explain complex emergent phenomena.

4. Working Examples

Looking back over decades and centuries of scientific research, many transdisciplinary thinking examples can be figured out even when the transdisciplinary concept itself did not have this name. We would like to present here an initial list of the most outstanding and promising ones. Usually these efforts are conceived at the conceptual level by a leading researcher and then followed by others over an interval of time that may span decades or even centuries to get its first experimental verification. Chronologically, we start with "primary water" in 1896, then the "equivalence principle" in general relativity theory (GRT) in 1915, the "wave-particle duality" (WPD) of quantum mechanics (QM) in 1924, quantum gravity (QG) in 2008, the "continuum-discrete duality" in computational information conservation theory (CICT) in 2013, etc. The present article focuses on the first three examples of this list only and the others are not considered here. Due to their importance, they will be addressed in a differed paper.

4.1. Example #1: Primary Water

The first example of transdisciplinary thinking comes from a group of researchers starting from Finnish and Swedish baron, geologist, mineralogist Nils Adolf Erik Nordenskiöld. In 1896, Nordenskjold, a Stockholm professor of mineralogy and Arctic explorer, published an essay, "About Drilling for Water in Primary Rocks" (Nordenskiöld, 1896), which was to win him a nomination for the Nobel Prize in physics, though he died before the prize was actually awarded. He was inspired by his father, the Chief of Mining in Finland, who told him that iron mines along the Finnish coast were never penetrated by sea water, but always had fresh water present. During the last part of the century, Nordenskjold was finding water by drilling into promontories and rocky islands off the Swedish coast. He concluded that water was formed deep within the Earth and could be found in hard rock. He called this water "primary," due to its association with so-called "primary rocks," which geologists term magmatic, or those, such as granites, basalts, and rhyolites, which derive from the molten magma deep within the Earth and later cool to crystallize into igneous rocks. He also affirmed that one could sink wells capable of producing such "primary water" year-round along the northern and southern coast of the Mediterranean Sea and in the whole of Asia Minor, precisely the best known part of the world afflicted with aridity.

The eminent mining geologist, Josiah Edward Spurr, in his two-volume treatise published in 1923, called attention to the fact that the existence of water as an essential component of igneous magmas had long been recognized. The existence was clearly shown by the vast clouds of water droplets that condense from the emitted vapor during volcanic eruptions. The fundamental idea that there is a thermodynamic cycle within the Earth that both produces and is fueled by water was still a concern at least up to 1942, when Oscar Meinzer, formerly head of the Groundwater Division of the U.S. Geological Survey in his book Hydrology (published in 1942), exposed the view that waters of internal origin are tangible additions to the Earth's water supply. Fifteen years before the publication of his book, Meinzer in a long essay referred to huge springs in the United States that yield 5,000 gallons or more per minute. This phenomenon is not confined to the United States. One incredibly productive water source flowing out of limestone is the Ain Figeh spring that alone supplies water for over one million residents of Damascus, Syria, and is also the principal source of the Barada River.

In the 1930s, Bavarian-born mining engineer and geologist Stephan Riess, while working in a deep mine at high elevation, after a load of dynamite had been set off in the bottom of it, was amazed to see water gushing out in such quantities that pumps installed to remove it at the rate of 25,000 gallons per minute could not make a dent in the flow. Staring forth into the valley below, Riess asked himself how water that supposedly had trickled into the Earth as rain could rise through hard rock into the shafts and tunnels of a mine nearly at the top of a mountain range. The temperature and purity of the water suggested to Riess it must have a completely different origin than ordinary groundwater. Since none of the textbooks he had studied had referred to what seemed to confront him as an entirely anomalous phenomenon, he decided to look into it further.

Research undertaken by Riess in 1934 showed enormous quantities of virgin water could be obtained from crystalline rocks. This involved a combination of geothermal heat and a process known as triboluminescence, a glow which electrons in the rocks discharge as a result of friction or violent pressure, that can actually release oxygen and hydrogen gases in certain ore-bearing rocks. This process, called "cold oxidation," can form virgin or primary water. Riess was able to tap straight into formations of hard desert rock of the right composition and produce as much as 8,000 liters per minute. Oxygen and hydrogen combine under the electromechanical forces of the earth to form liquid water. In 1957, after Riess had been working on the problem for nearly two decades, Encyclopedia

Britannica's Book of the Year ran the following statement: "Stephan Riess of California formulated a theory that 'new water' which never existed before, is constantly being formed within the earth by the combination of elemental hydrogen and oxygen and that this water finds its way to the surface, and can be located and tapped, to constitute a steady and unfailing new supply."

In 1960, Michael Salzman, then a professor at the University of California's School of Commerce, who had served as an engineer with the U.S. Navy's Hydrographic Office, summed up his research work of over thirty years in the book titled "New Water for a Thirsty World" underlining the limitations of modern hydrology science, concerned exclusively with the hydrologic cycle in all of its various aspects (Salzman, 1960). Modern hydrology, as a science, is considered to have begun with the work of Pierre Perrault (1608-1680) and of Edme Mariotte (1620-1684). These men had, for the first time, put hydrology on a quantitative basis. The science of hydrology has progressed from these early beginnings, but it must be realized that it deals exclusively with surface water run-off and ground water run-off through pervious granular materials and that these ignore consolidated rock fissure waters for all practical purposes and the chemistry of the earth, the chemical reactions which produce the waters of internal origin. Salzman put into evidence our ignorance about geochemistry vs. hydrology, and mental blocks. They exist because thinking processes follow along certain patterns that have been molded and shaped by training, and by the social, psychological, and economic environment of the individual. In essence, mental blocks are the result of self-imposed restrictions, which are unknowingly interposed and which sometimes prevent the solving of problems.

Within the thin crust of the earth are temperatures that vaporize iron and pressures that keep molten rock solid. Absorbed in everyday life problems, man is nonetheless periodically reminded of the deep mysteries beneath his feet when the elemental forces of pressure and high temperature breach a fracture in the earth's crust (Coghlan, 2017). Salzman gave ample evidence of dynamic earth, to show the existence of magmatic, metamorphic, and volcanic water. Indeed, the origin of the earth's water supply is thought to be derived from the interior of the earth. Riess drilled 753 documented primary water wells on four continents successfully. Today such projects are underway in Nigeria, Madagascar and many more (PWT, 2017).

Salzman's transdisciplinary vision aggregated the relational knowledge on geochemistry, petrology, mineralogy, crystallography, physical chemistry, as well as structural geology to offer his new worldview of a dynamic earth crust. He concludes his book remembering that with proper management, this earth can abundantly supply its inhabitants with all they require. But this is not the route we travel; to change our course requires meaningful education and understanding. "History is," as H. G. Wells describes it, "a race between education and catastrophe." What is your choice?

4.2. Example #2: General Relativity Theory (GRT)

The second example of transdisciplinary thinking comes from the German-born theoretical physicist Albert Einstein with the enunciation of his "equivalence principle" (EP) for General Relativity Theory (GRT). In GRT, the EP is any of several related concepts dealing with the equivalence of gravitational and inertial mass, and to Albert Einstein's observation that the gravitational "force" as experienced locally while standing on a massive body (such as the Earth) is actually the same as the pseudo-force experienced by an observer in a non-inertial (accelerated) frame of reference. GRT is a theory of gravitation that was developed by Albert Einstein between 1907 and 1915, with contributions by many others after 1915. According to GRT, the observed gravitational attraction between masses results from the warping of space and time by those masses. To the interested reader, a brief historical development of this theory is referred to as HGRT (2017).

Einstein's ground-breaking realization (which he called "the happiest thought of my life") was that gravity is in reality not a force at all, but is indistinguishable from, and in fact the same thing as, acceleration, an idea he called the "principle of equivalence." He realized that if he were to fall freely in a gravitational field (a skydiver before opening his parachute, or a person in an elevator when its cable breaks), he would be unable to feel his own weight, a rather remarkable insight in 1907, many years before the idea of freefall of astronauts in space became commonplace.

So, gravity, Einstein realized, is not really a force at all, but just the result of our surroundings accelerating relative to us. Or, if there is perhaps a better way of looking at it, gravity is a kind of inertial force, in the same way as the so-called centrifugal force is not a force in itself, merely the effect of a body's inertia when forced into a circular path. In order to rationalize this situation, though, Einstein was to turn our whole conception of space. In fact, according to Einstein's worldview, matter does not simply pull on other matter across empty space, as Newton had imagined. Rather matter distorts spacetime and it is this distorted spacetime that in turn affects other matter. Objects (including planets, like the Earth, for instance) fly freely under their own inertia through warped spacetime, following curved paths because this is the shortest possible path (or geodesic) in warped spacetime.

In theoretical physics, a mass generation mechanism is a theory which attempts to explain the origin of mass from the most fundamental laws of physics. To date, a number of different models have been proposed which advocate different views of the origin of mass. The problem is complicated by the fact that the notion of mass is strongly related to the gravitational interaction but a theory of the latter has not yet been reconciled with the currently popular model of particle physics, known as the Standard Model mentioned in the previous section (yes, we know about the Higgs Boson mechanism, but its reality is substantiated by only one experimental laboratory evidence in the world. No other lab elsewhere is able to repeat that experimentation currently). On the other hand, inertial mass is the mass of an object measured by its resistance to acceleration.

Einstein's transdisciplinary vision aggregated the relational knowledge on energy, gravitational mass, inertial mass, mechanics, dynamics and geometry offering a unique new worldview. That is the reason for the well-known term "geometrodynamics" which is as a synonym for "general relativity." More properly, some authors use the phrase "Einstein's geometrodynamics" to denote the

initial value formulation of general relativity, introduced by American physicists Richard L. Arnowitt, Stanley Deser, and Charles W. Misner (ADM formalism) around 1960. In this reformulation, spacetimes are sliced up into spatial hyperslices in a rather arbitrary fashion, and the vacuum Einstein field equation is reformulated as an evolution equation describing how, given the geometry of an initial hyperslice (the "initial value"), the geometry evolves over "time." This requires giving constraint equations which must be satisfied by the original hyperslice. It also involves some "choice of gauge"; specifically, choices about how the coordinate system is used to describe how the hyperslice geometry evolves.

During the 1950s American theoretical physicist John A. Wheeler developed a program of physical and ontological reduction of every physical phenomenon to the geometrical properties of a curved space-time in an even more fundamental way than the ADM reformulation of general relativity, with a dynamic geometry whose curvature changes with time, called "Geometrodynamics" (Wheeler, 1962). He wanted to lay the foundation for "quantum gravity" and unify gravitation with electromagnetism (the strong and weak interactions were not yet sufficiently well understood in 1960). Wheeler introduced the notion of "geons," gravitational wave packets confined to a compact region of spacetime and held together by the gravitational attraction of the (gravitational) field energy of the wave itself. Wheeler was intrigued by the possibility that geons could affect test particles much like a massive object, hence mass without mass.

In the ADM reformulation of general relativity, Wheeler argued that the full Einstein field equation can be recovered once the momentum constraint can be derived, and suggested that this might follow from geometrical considerations alone, making general relativity something like a logical necessity. Specifically, curvature (the gravitational field) might arise as a kind of "averaging" over very complicated topological phenomena at very small scales, the so-called "spacetime foam." This would realize geometrical intuition suggested by quantum gravity, or field without field.

More recently, theoretical physicist Christopher Isham, philosopher Jeremy Butterfield and their students have continued to develop quantum geometrodynamics to take account of recent work toward a quantum theory of gravity and further developments in the very extensive mathematical theory of initial value formulations of general relativity. Some of Wheeler's original goals remain important for this work, particularly the hope of laying a solid foundation for quantum gravity. The philosophical program also continues to motivate several prominent contributors. Topological ideas in the realm of gravity date back to Riemann, Clifford and Weyl who found a more concrete realization in the wormholes of Wheeler characterized by the Euler-Poincaré invariant.

GRT has been proven remarkably accurate and robust in many different tests over the last century. The slightly elliptical orbit of planets is also explained by the theory but, even more remarkably, it also explains with great accuracy the fact that the elliptical orbits of planets are not exact repetitions but actually shift slightly with each revolution, tracing out a kind of rosette-like pattern. For instance, it correctly predicts the so-called precession of the perihelion of Mercury (that the planet Mercury traces out a complete rosette only once every 3 million years), something which Newton's Law of Universal Gravitation is not sophisticated enough to cope with.

Almost a century later, GRT remains the single most influential theory in modern physics, and one of the few that almost everyone, from all walks of life, has heard of (even if they may be a little hazy about the details). Einstein's GRT predicted the existence of black holes many years before any evidence of such phenomena, even indirect evidence, was obtained. Yet another theoretical prediction of GRT is the existence of gravitational waves, perturbations or ripples in the fabric of space-time, caused by the motion of massive objects, that propagate throughout the universe as objects are squeezed on a subatomic scale. There has been good circumstantial evidence for these elusive waves since the 1970s, but it was only in late 2015 that gravitational waves were definitively observed at the twin Laser Interferometer Gravitational-wave Observatory (LIGO) detectors in the USA. This potentially opens up a whole new way of looking at the universe. On this line of thinking, something like the Einstein EP, worth mentioning, emerged in the early 17th century, when Galileo expressed experimentally that the acceleration of a test mass due to gravitation is independent of the amount of mass being accelerated. This is known as the "weak equivalence principle," also known as the "universality of free fall" or the "Galilean equivalence principle." The weak EP assumes falling bodies are bound by non-gravitational forces only (Wagner et al., 2012). The strong EP (Einstein equivalence principle) includes (astronomic) bodies with gravitational binding energy.

On 14 September 2015, the universe's gravitational waves were observed for the very first time. The waves, which were predicted by Albert Einstein a hundred years ago, came from a collision between two black holes. It took 1.3 billion years for the waves to arrive at the LIGO detector in the USA. In 2017, Rainer Weiss, Barry C. Barish and Kip S. Thorne, were awarded the Nobel Prize in Physics "for decisive contributions to the LIGO detector and the observation of gravitational waves" (TNPP, 2017). It is also another indication of just how robust the GRT is. Gravitational waves spread at the speed of light, filling the universe, as Albert Einstein described in his GRT. They are always created when a mass accelerates, like when an ice-skater pirouettes or a pair of black holes rotate around each other. Einstein was convinced it would never be possible to measure them. The LIGO project's achievement was possible by using a pair of gigantic laser interferometers to measure a change thousands of times smaller than an atomic nucleus, as the gravitational wave passed the Earth. Gravitational waves are direct testimony to disruptions in spacetime itself. This is something completely new and different, opening up unseen worlds. A wealth of discoveries awaits those who succeed in capturing the waves and interpreting their message.

4.3. Example #3: All matter has wave properties

The third example of transdisciplinary thinking comes from French physicist Louis de Broglie with the enunciation of his "wave-

particle duality" (WPD) principle. In his 1924 PhD thesis he postulated the wave nature of electrons and suggested that all matter has wave properties. This concept is known as the "de Broglie hypothesis," an example of WPD, and forms a central part of the theory of quantum mechanics (de Broglie, 1926). The 1925 pilot-wave model, and the wave-like behaviour of particles discovered by de Broglie was used by Erwin Schrödinger in his formulation of wave mechanics (Valentini, 1992). The pilot-wave model and interpretation was then abandoned in 1927, in favor of the quantum formalism, until 1952 when it was rediscovered and enhanced by David Bohm.

In theoretical physics, the pilot wave theory, also known as "Bohmian mechanics," was the first known example of a hidden variable theory, presented by Louis de Broglie in 1927 (de Broglie, 1927). De Broglie won the Nobel Prize for Physics in 1929 (TNPP, 1929) "for his discovery of the wave nature of electrons", after the wave-like behaviour of matter was first experimentally demonstrated in 1927 by the Davisson–Germer experiment (DGE, 2017). De Broglie's transdisciplinary vision aggregated relational knowledge on energy, inertial mass, wave mechanics and dynamics in a unique new worldview.

In quantum mechanics, the Schrödinger equation is a mathematical equation that describes the changes over time of a physical system in which quantum effects, such as WPD, are significant. The equation is a mathematical formulation for studying quantum mechanical systems. It is considered a central result in the study of quantum systems and its derivation was a significant landmark in developing the theory of quantum mechanics. It was named after Erwin Schrödinger, who derived the equation in 1925 and published it in 1926 (Schrödinger, 1926). It formed the basis for his work that resulted in his being awarded the Nobel Prize in Physics in 1933 (TNPP, 1933), together with Paul Adrien Maurice Dirac "for the discovery of new productive forms of atomic theory."

The de Broglie–Bohm theory, also known as the "pilot wave theory," "Bohmian mechanics," "Bohm's interpretation," and the "causal interpretation," is a deterministic interpretation of quantum theory. In addition to a wavefunction on the space of all possible configurations, it also postulates an actual configuration that exists even when unobserved. The evolution over time of the configuration (that is, the positions of all particles or the configuration of all fields) is defined by the wave function by a "guiding equation." The evolution of the wave function over time is given by Schrödinger's equation. The theory is deterministic (Bohm, 1952) and explicitly nonlocal: the velocity of any one particle depends on the value of the guiding equation, which depends on the configuration of the system given by its wavefunction; the latter depends on the boundary conditions of the system, which in principle may be the entire universe. The theory results in a measurement formalism, analogous to thermodynamics for classical mechanics, that yields the standard quantum formalism generally associated with the Copenhagen interpretation. The theory's explicit non-locality resolves the "measurement problem", which is conventionally delegated to the topic of interpretations of quantum mechanics in the Copenhagen interpretation.

Scientists have uncovered a great similarity between fluid dynamics and the WPD of quantum mechanics. We should not take macroscopic analogy as proof of microscopic reality, but certainly it demonstrates that this sort of behavior does happen in this universe, at least on some scales. Furthermore, it suggests that the mathematics of quantum mechanics represents the physics of "time," with classical physics representing long-term statistical behavior of processes over a period of time as in Newton's differential equations. In 1831, English scientist Michael Faraday was the first to notice oscillations of one frequency being excited by forces of double the frequency, in the crispations (ruffled surface waves) observed in a wine glass excited to "sing" (Faraday, 1831). Faraday waves, also known as "Faraday ripples," are nonlinear standing waves that appear on liquids enclosed by a vibrating receptacle. When the vibration frequency exceeds a critical value, the flat hydrostatic surface becomes unstable. This is known as the "Faraday instability." Faraday described them in an appendix to an article in the Philosophical Transactions of the Royal Society of London in 1831 (Faraday, 1831). The Faraday wave and its wavelength at system macroscale level is analogous to the de Broglie wave with the de Broglie wavelength in quantum mechanics being at quantum level (Bush, 2010). In 1860 German physicist Franz E. Melde generated parametric oscillations in a string by employing a tuning fork to periodically vary the tension at twice the resonance frequency of the string (Melde, 1860). Parametric oscillation was first treated as a general phenomenon by Lord Rayleigh (Strutt, 1883, 1887).

Floating droplets on a vibrating bath were first described in writing by Jearl Walker in a 1978 article in Scientific American (Walker, 1978). In 2005 a French team of scientists, led by physicists Yves Couder and Emmanuel Fort, discovered that a millimetric droplet bouncing on the surface of a vibrating fluid bath can self-propel by virtue of a resonant interaction with its own wave field (Couder et al., 2005a, 2005b). This system represents the first known example of a pilot-wave system of the form envisaged by Louis de Broglie in his double-solution pilot-wave theory at system macroscale level (deBroglie, 1987; Milewski et al., 2015). Couder and associates set up an experiment of an oil-filled tray placed on a vibrating surface. When a drop of the same fluid is dropped onto the surface of the vibrating fluid, the droplet bounces on the surface of the fluid, rather than simply losing its shape upon impact. This bouncing droplet produces waves on the surface and these waves cause the droplet to move along the surface. This system was used to reproduce one of the most famous experiments in quantum mechanics called the double-slit experiment in 2006 (DSE, 2017). It is interesting that even if the bouncing droplet represents a whole atom surrounded by an electron probability cloud the atom can go through either slit with the probability cloud going through both forming an interference pattern. Subsequent experimental work by Couder, Fort, Protiere, Eddi, Sultan, Moukhtar, Rossi, Molacek, Bush and Sbitnev has established that bouncing drops exhibit single-slit and double-slit diffraction, tunnelling, quantised energy levels, Anderson localisation and the creation/annihilation of droplet/bubble pairs (Brady & Anderson, 2014).

Therefore, the bouncing droplet can represent the "particle" nature of a photon or electron and the waves on the surface of the fluid can represent the wave nature that can go through both slits at the same time. If we break the experiment of bouncing

droplets down into individual parts and ask ourselves what each part could represent in the quantum world of the atoms it could give us a greater picture or understanding of quantum mechanics. In fluid dynamics, the double-slit experiment and the Copenhagen interpretation could be effectively represented where the fluid is the structure of spacetime and the quantum level is composed of little electromagnetic oscillators of the Planck size, also known as zero-point vacuum energy in quantum field theory (QFT). As a matter of fact, a walking droplet on a vibrating fluid bath was found to behave analogously to several different quantum mechanical systems, namely particle diffraction, quantum tunneling, quantized orbits, the Zeeman effect, and the quantum corral (Bush, 2017). It was also found that, quite similar to pilot wave theory, current hydrodynamic model incorporates the nonlocality which is a characteristic feature of hidden variable theories.

We know that the Universe is never at absolute zero therefore there is always the spontaneous absorption and emission of photon energy forming photon oscillation or vibrations. This process will naturally form the continuously vibrating surface of the tray in the experiment. We know that light has momentum and that momentum is frame dependent. Also we know that the light photon forms the movement of charge with the continuous flow of electromagnetic fields relative to the atoms of the periodic table. Therefore, the droplet can represent a photon, electron or an atom within its own reference frame and the waves can represent electromagnetic waves with charge being an innate part of all matter. Therefore, the structure of spacetime is not merely curved to produce gravity but is well curled, like water spinning down the drain. And this can take place in just three dimensions over a period of time without the extra dimensions of "String Theory" or the "parallel universes" of Hugh Everett's "many worlds" interpretation.

5. Conclusion

To provide reliable anticipatory knowledge, a system must produce predictions ahead of the predicted phenomena as fast as possible. Then, they have to be verified by a reality level comparison, to be validated and accepted, and then to be remembered as learned reliable predictions. This validation cycle (emulation) allows system tuning and adaptation to its environment automatically and continuously. We need to recall Arthur Koestler's words (Koestler, 1959):

> *"The inertia of the human mind and its resistance to innovation are most clearly demonstrated not, as one might expect, by the ignorant mass--which is easily swayed once its imagination is caught--but by professionals with a vested interest in tradition and in the monopoly of learning. Innovation is a twofold threat to academic mediocrities: it endangers their oracular authority, and it evokes the deeper fear that their whole, laboriously constructed intellectual edifice might collapse. The academic backwoodsmen have been the curse of genius from Aristarchus…; they stretch, a solid and hostile phalanx of pedantic mediocrities, across the centuries."*

Current traditional formal systems are unable to capture enough information to model natural systems realistically. They cannot capture, represent and describe real system emergent properties effectively. It is time for an Ontological Uncertainty Management (OUM) system upgrade (Fiorini, 2017c).

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Universities and Knowledge for Sustainable Urban Futures: as if Inter and Trans-disciplinarity Mattered

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Abstract

The aim of this presentation is to show the results of the 'London Workshop' held in March 2017, which was supported by the EU COST Action 'INTREPID', which was meant to advance the agenda of "Universities and Knowledge for Sustainable Urban Futures: as if ID and TD mattered". Academics and practitioners have discussed in a world café format how to characterise the 'Status quo' of University today, identifying its 'Drivers of/for change', 'Values to guide change' and 'Uncertainties, obstacles, opportunities'. The idea of the Future-of-U (Future of Universities) has been introduced during the final joint discussion alongside the identification of a range of themes tentatively categorised under ethos, purpose and qualities. Two possible ways forward have been also discussed. To read the full research report, click here.

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SECTION 7

TOOLS/CATALYSTS IN THE TRANSFORMATION PROCESS

The Teacher as Catalyst: Skills Development & Self-Discovery in Group Contexts

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Abstract

Recent reports note that college does not prepare its graduates for the jobs of the future. The need is no longer for technical knowledge and traditional skills but a skill set that will help the transition to a rapidly changing work place. Top skills now include communication and problem solving, and ability to think creatively. These and other capabilities in fact can be developed within the current curriculum through the actions and interactions of the students themselves. Here the teacher functions as a kind of catalyst as he/she introduces small group discussion and group projects as a natural part of the course work. Their role is essentially that of a catalyst, because he/she initially makes the students talk to one another! He/she also provides the groups with provocative questions and problems relating to the common course material, as well as mini-lectures on good group practices. Group work in class might be just a 10-15 minute discussion of a question relating to common class material (preferably controversial), after which each group announces its conclusion, and the teacher takes it forward from there. Other bigger group projects can develop students' presentation skills and their creative imagination. Those projects will also be valuable lessons in team work. As students express themselves, take on different roles, learn from mistakes, and meet new challenges, group work becomes a venue for self-discovery and development of hidden potentials. Also, intercultural and inter-professional communication skills can be developed this way. Alternatively, term-long Interprofessional Projects have been developed to directly address the need for new skills.

1. The Challenge

There is a current concern about the speed of technical development and the relative lag of training of the work force. Recent reports note that our current educational system does not prepare college graduates for their future jobs. There is a mismatch between what they are learning and what the workplace will require. In technical fields trends are seen as developing so fast that the knowledge obtained in the first year of college will be obsolete at graduation (e.g., The Future of Jobs Report, 2016; What Graduates Need to Succeed, 2017).

Moreover, and perhaps more alarmingly, the critical issue for graduates is no longer the possession of technical knowledge and skills. Those are envisioned as less important than broad basic skills that will help students' transition to a rapidly changing work place. Employers now want their employees to be pre-trained; there will no longer be time for on-the-job training.

What kind of education, then, would be needed to generate the right kind of preparedness so that students can make a smooth transition from school to employment? How can they develop a set of skills and competencies that will enable them to "hit the ground running" in a future environment where workplace training has been eliminated?

2. What Do Employers Want?

What are those coveted skills? For many technical high achievers, it may come as a surprise that the issue at stake for future employers is not technical competence. Instead, the top desired competencies include such things as communication and problem solving skills, and the ability to think creatively—in other words, the current emphasis is on cognitive and social rather than technical qualifications! There is wide agreement about this across industrial fields. Moreover, students are expected to have these capabilities ready at their finger tips! So one natural question arises: Is it possible to address this felt need within the present educational system, or will it only happen through the latter's total "disruption", as some forecasters warn?

When employers are talking about communication, what do they actually mean? Do they mean mastery of sophisticated information technology? No, it seems they actually mean good old-fashioned communication. Some employers have particularly emphasized the importance of internal communication in the workplace. What do they have in mind? I believe one problem is that people have taken to emailing each other in the work place even if they could easily visit one another in person, which may increase misunderstandings and delay feedback. Email communication, while it is effective, is not optimal. There are questions that do not get asked, and information that does not get effectively transmitted… Meanwhile those same things might have been handled in face-to-face conversations and been resolved on the spot.

3. What Is to Be Done?

The current knowledge-oriented educational system is clearly not geared up for quick delivery of students with such a demanding set of skills and abilities. But it could be argued that at least part of the needed skills set is being covered at least implicitly. Also, many curricula include internships and practical training, as well as opportunities for "experiential learning" and "service learning". And outside the classroom, students become active in student organizations, sports, etc. In these and many other ways in the university setting, some of the desired skills and abilities are in fact getting developed.

A short term response to the challenge, therefore, might be to try to make manifest the skills and competencies addressed within the frame of a particular course (for instance, communication, logical reasoning, critical thinking, cultural understanding, ethical

reasoning, etc) and explicitly identify how these relate to the desired skill set needed for the future. (This might, incidentally, inspire a radical rethink of the crucial role of the Humanities, which have recently been deemphasized in favor of technical knowledge—which, as we just learnt, has lost some of its status).

However, I have a specific "fix" in mind, as we wait for major educational reform or the envisioned major disruption. I believe we can begin the needed skill building and skill training within the current system of education by using the wonderful power of our students, starting right now.

4. Challenging the Industrial Model

On the last day of the conference, a young French architect raised her hand and noted how ironical it was to talk about the future of education in a lecture hall clearly built to serve an outdated educational philosophy. She was right. We were sitting in an enormous room with inflexible long rows of benches for hundreds of students—as antithetical to developing the desired new skill set as could be imagined.

The current system of education and its spatial setup are connected to an earlier era's need for a disciplined industrial work force, expected to learn and obey. But over time things have changed—new demand is now for active workers, people that think creatively and critically, and communicate well. This makes our traditional classrooms look as if they actively wished to quench the vitality and initiative expected of the future work force. But we can overcome this obstacle by helping the students develop those precious new skills and capabilities and bring in the power of the students themselves. Chaos in the classroom! shouts an ancient disciplinarian from the woodwork. Not necessarily, we answer—let's just call it "organized spontaneity" instead…

One thing that we will be doing is re-emphasizing face-to-face conversation. This, in fact, is a quite serious issue. Recently, the speed and accessibility of electronic media have been challenging this important mode of communication, with all the valuable nonverbal cues and instant feedback it enables. Sherry Turkle in her book *Reclaiming Conversation: The Power of Talk in a Digital Age* (2015) makes a number of good points warning us about the various pressures put on us by the electronic media in our lives and work. For instance, multitasking sounds great but does not really work as believed. Meanwhile, under the pressure to do things faster, we may lose our important capability for deep reading and understanding. There is now increasing research on the actual addictiveness of social media, and special treatment programs for cell phone addicted youngsters.

5. Empowering Students

Students need to be put more in charge and given room for experimentation and reflection. And there should be plenty of room for making mistakes, as Nora Bateson revealed in her lecture at this conference, her father's notion of "learning to learn" actually had to do with our willingness to learn from our mistakes. ("Learning to learn" was titillatingly metaphysical-sounding to me when I read Gregory Bateson's famous *Steps to an Ecology of Mind* as a student of communication, Bateson, 1985).

The first important thing is to get students to talk to one other! It is surprising how little contact students in the same class may have outside the classroom. This is a terrible waste of opportunity. I reason that students in general would like to talk with each other, but since they don't know each other they do not, and the result is a sea of disconnected individuals. But this is where the teacher comes in—she/he can arrange for students to formally "meet", quite legitimately, around small group tasks! It only takes asking students to form small groups in class to discuss some chosen question. It may surprise the students but they will do it, and that is the beginning of a new life in class. This should be done early in the semester and it is also good to assign early homework projects that involve group collaboration outside class. The idea is for the whole class to eventually get acquainted through participating in various group activities.

Being part of a small group will help students overcome the inhibitions that otherwise prevent them from speaking in class. Speaking in class is quite terrifying for many, which is understandable, but this inhibition will just have to be overcome, the sooner the better, and the teacher can facilitate this by forming groups. It is more natural and less scary to open one's mouth in a small group. The larger aim of course is to build a class climate where every student will *want* to participate.

The sheer presence of people that one feels one can count on can make a great difference. My ambition to get students to know each other aligns directly with the important research cited by Stefan Brunnhuber in his presentation at this conference: much of student success and retention can be shown to be directly dependent on extracurricular factors! And here one of the most important factors turned out to be having a friend in the class.

The next step, then, is to use the small group idea to develop those much desired skills of communication, problem solving, creativity, and other capabilities within the framework of the existing curriculum. I see this happening through the actions and interactions of the students themselves, as the teacher makes small group discussions and group projects a natural part of the course work. It is not necessary to sacrifice a lot of precious class time, but group work has to become a regular feature of the class work.

Those early group discussions might be just a 10 minute discussion of a question relating to the class material (a video, reading, etc). Then someone in each group reports the group's conclusion to the class as a whole, and this in turn gives the teacher material for a quick comparison and possible general class discussion. Topics that are emotionally engaging or involve moral judgment tend to particularly activate the class and encourage even shy students to speak up.

Apropos speaking up, there is a lot of background noise in some class rooms, and students tend to mumble or not realize that they have to speak louder or project their voice in a class room setting. Speaking clearly is another thing the students also must learn. I

have in fact taken to just telling mumbling students to speak up so that their class mates can hear them. Paying attention to the sound of one's voice is very important and a transferable skill. Meanwhile it benefits the whole class—and me.

6. Developing Skills through Group Work

In addition to ad hoc groups for discussing certain issues during lectures, there can be group projects of a more long-term kind. For instance, in a class for architects I have them identify and analyze a particular thematic environment using concepts from our class. They are then to recreate the particular environment and experience for us in a class presentation (how do you best convey the spirit of the Rainforest Café?). In another class, students form interest groups around various emerging technologies, preparing final presentations about each technology's technical feasibility and potential social impact. Projects like this develop students' analytical and presentation skills as well as their creative imagination, and they gain experience of cooperative learning and work.

At the same time, such bigger projects are naturally also exercises in team work. But students need to know that team work is something that has to be learnt. So here the teacher needs to give a timely mini lecture about the basic idea of team work and team leadership, while letting the students decide about their own teamwork rules and division of labor. She/he may also now take the opportunity to warn about typical problems with group work, such as the infamous "group think" and the ubiquitous "free rider phenomenon", maybe inviting a discussion about potential remedies.

More permanent groups might also try their hand at available techniques for idea production, decision making, and problem solving. Also, if time allows, trying out techniques and tools for creativity may become another part of the group work, as may some tools for group self-analysis. All this familiarizes the students with group work (and its problems), and they will be able to refer to their various experiences and training of particular group working skills in their job resumes. (One such skill is listening!)

7. How Groups Can Help Students' Self-Discovery

Group work and team work may also be venues for self-discovery and development of hidden potentials, as students take on various roles, meet new challenges, and reflect on their experience. The thing to remember is that college students are still growing, both physically and mentally, and under our eyes. They need to be exposed to different environments and experiences to find out more about themselves and how they respond.

A good case is a female student who discovered that she loved doing research and that she had natural leading abilities. This insight came to directly impact her future career choice. Another very quiet student found herself becoming the leader of a group of males in a project on the feasibility of human exoskeletons. Other students have surprised me with their great class presentations—their passion for the subject matter can turn quiet students into eloquent speakers.

A good example of discovering new capabilities in oneself is a group project involving educational geography and astronomy games for middle-school students. (This was part of a social communication class). At one point the middle school students visited our class to test the games and give our project groups critical feedback. Here I saw a completely new side of my male students: they turned out to be surprisingly good at interacting with their young "customers", patiently explaining their games to them, eliciting feedback and accepting criticism.

Small group discussion is also an excellent way to dealing with values—not least making clear one's values to one self. I often ask students for their moral and ethical judgment of the behavior of scientists—say, of Jim Watson as he depicts himself in his book *The Double Helix* (Watson, 1980), compared to others' description of him, and last but not least, in relationship to the established norms of science. Students are interested in judging people's motives, values, and behavior, and intense discussions often ensue. Challenged by others, students have to figure out why they take a particular stance on an issue.

My paper so far has discussed how skills training and self-discovery may be started already within the framework of the existing curriculum, and I have suggested the strategic use of discussion groups and group projects for achieving this goal. An advanced option would be to include in the curriculum whole courses devoted exclusively to project based learning and the development of a certain skill set.

This is exactly the idea of the existing IPRO requirement at Illinois Tech. In order to graduate, every student must have taken two of these IPROs, first a "practice" one, explicitly designed to acquaint students with various existing methods and techniques, and the other, a "real" IPRO, which involves identifying a suitable project, solving problems as they arise, and perhaps coming up with a patentable idea. A "real world" touch comes from the fact that the second IPRO typically involves sponsorship and involvement from some company. The point of these projects is for the faculty member to give the students as much initiative as possible, acting more as a facilitator, resource person, and "remote controller" than a project manager. Meanwhile, concrete advice about such things as model building and prototyping can be obtained by an adviser in the university's Idea Shop. The projects are then exhibited, presented and assessed by judges on the yearly IPRO Day.

8. The Teacher as Catalyst

I think the teacher is best described as a catalyst—her/his sheer presence causes things to happen. A catalyst makes things happen that might not otherwise come about—students in class actually talking to each other, actively discussing course material, and collaborating on group presentations. They function as a catalyst, because she/he makes the students initially talk to one another in a small group setting, provides suitable discussion questions for their discussion, as well as mini lectures regarding good group

practices and avoidable dangers. But the teacher also has other roles—especially as someone who encourages students, introduces them to a world of values, opens up new theories and results for them to consider, and provides them with suitable challenges. The teacher is on the students' side, working with them as they develop and find themselves and their strength. A personal goal for each student might be to find the conditions for the particular state called "flow". Experiencing flow means being so intensely immersed in a task or activity that one forgets time and space. This requires a challenge that is not too difficult and not too easy, but just right (Csikszentmihalyi, 2009). Some students have reported feeling flow when doing homework in computer science or architectural drawing, others in running, playing instruments, or dancing. Mere listening to others' descriptions already broadens the imagination—and connects the students to each other.

In this essay I have been arguing for the introduction of various group experiments and for making project based learning part of the overall university education. Team-based project-based learning can in principle result in a win-win situation for both the students and the "client". Prototypes may be further developed, and models and procedures transferred to other contexts. The overall pedagogical challenge is to structure the projects in the right way to bring out and nurture the students' natural enthusiasm and creativity and help nurture an attitude that welcomes learning new things. Such team projects teach not only "learning by doing" but also problem-solving through cooperation with people of different backgrounds, interests and skills. Such projects need to become an important part of education and receive appropriate academic credit, since they are the tickets to the future.

What, then, about traditional "academic" type knowledge? There is a good amount of extremely useful "real world knowledge" which is, alas, not part of the academic core curriculum. I refer largely to knowledge from social psychology and interpersonal communication. For instance, most individuals are unaware that our minds are not neutral but biased in various well-known ways, that situational factors and group phenomena may change our individual judgment under certain conditions, and that good group decision-making (just as good team work) is an achievement rather than a given. Meanwhile, differences in cultural expectations, conversational style, and non-verbal behavior easily give rise to misunderstandings. Knowledge of this at an early age can improve the quality of life (and make lives for the Machiavellians of this world more difficult).

Useful knowledge of this kind needs to be incorporated as a matter of course in the curriculum. In this way schools should help provide a realistic context for students to find their individual strengths and interests and develop their inner potential.

9. Steps to an Ecology of Education

After the presentation of my paper at the Rome conference, one lady in the audience asked where I have learnt my teaching style. As I explained to her, I believe my own training as a teacher comes primarily from having worked as a teaching assistant in 11 different undergraduate courses as a graduate student at Harvard, including history and literature, experimental psychology, history of science, and non-verbal communication. All fascinating topics, which I was learning all by myself while leading the weekly discussions in batches of 20 students (I describe this in Gullette, 1984). Getting students to talk led me to develop a kind of Socratic method which involved in principle every student. Later at Illinois Tech I developed my own courses addressing among other things how science is actually done and how regular people experience architecture… I was aiming for a "learning-by-doing" or "learning-by-experiencing" approach, while challenging students to come up with creative solutions. The TA training seminars by legendary Professor Christensen at Harvard Business School had already convinced me of the pedagogical power of good case studies, and I naturally came to emphasize what Janani Harish calls "contextual knowledge" (Harish, 2015).

Finally, I should probably mention that I regard myself as an educational experimentalist—for me teaching is an ongoing research process. This essay is largely a report of actual experiments that I have tried. Has there been any success?

Of course American students are great in sports and in that they never complain that something is undoable—they just do it. But my system has worked also with Swedish speaking students at Abo Akademi University in Turku, Finland, and Swiss students at ETH in Zurich. But where did I get the idea of using slight provocation, challenge and surprise? I track that back to my friendly high school math teacher who did things like hinting at a "trick" in problem number 3—which immediately turned solving it into a sport in our class. I believe I am continuing this tradition of seeing learning and discovery as adventures as they did. The real adventurers, however, are the students, and we teachers will do well to serve as their tour guides and facilitators, hoping to catalyze amazing developments.

I regard myself as participating in the unfolding of the capabilities of our students, hoping that my encouragement and attempts to "catalyze" are bringing results. Meanwhile I see as a positive sign the feedback I got from my university last year in the form of the Trustees Outstanding Undergraduate Teaching Award.

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The Future of Higher Education: The Role of Basic Values

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1. The Future of Higher Education: The Role of Basic Values

I. Education, and particularly higher education, imparts to the participants in education fundamental thinking skills that with extended immersion in educational processes are fundamentally concerned with human thinking and how to improve the human capacity for thinking in terms that are socially and personally constructive. Thinking skills are intimately integrated into the human subjectivity of human perspective. Human perspective in turn, is intimately connected with the purpose of human activity. Purpose of human activity is overwhelmingly implicated in the pursuit of human values. The educational process that seeks to improve the methods of human thinking are therefore inextricably bound up with the training of human perspective, which is intricately bound up with the pursuit of human values. The fundamental idea behind all educational processes is still the challenge of education to understand how human beings think, and how to improve the process of thinking. The thinking process that evolves as a component of human subjectivity is significantly directed as the need for the individual self-system to identify, understand and, ultimately, solve problems. The importance of problem solving in the context of the future of higher education is complex since the knowledge generating fields are organized in terms of discreet disciplinary methods and procedures. Problem solving must therefore find the method and the means for exploring, comparing, contrasting and integrating a universe of multiple disciplines all of which are relevant to the evolving human subjectivities of the participators in higher education.

II. Dewey, in his famous book, "How We Think"[1], set out the challenge that all human beings from infancy through life have to develop the thinking skills necessary to successfully **identify** the problems they encounter, and to develop increasingly sophisticated intellectual procedures to solve the problems that have been identified. Problem solving involves a critical faculty in the self-system of the human being. This faculty is the faculty of making choices about the implications of values and problems of importance to the individual and society. In effect, this means that choice itself is a matter of the individual exercising the challenge of informed decision making, hopefully in the interest of the individual and the common interest of the community.

III. Dewey, and later Lasswell, sought to clarify the precise intellectual procedures that an individual may acquire and refine in order to be a successful participator in solving personal and social problems.

2. Intellectual Procedures for Problem Identification, Problem Solving and Decision Making

I. These intellectual procedures and skills are each distinctive and, at a sophisticated level, involve methods and procedures for increasing skills and sophistication. These thinking skills require immersion in knowledge-generating disciplines as well as integration of that knowledge in terms of problems and solutions in the form of decision making which challenge the intellect in terms of decisions that are good for the individual, society and for those who reproduce the opposite result.

II. The intellectual tools identified by Dewey and Lasswell and their associates are as follows:

3. Five Intellectual Skills Critical to the Future of Higher Education[2]

The Relevance of Values and Goals[3]
– The clarification of values and goals (the relevance and challenge of values)

The Description and Relevance of Trend[4]
– The description of trend (historical description and analysis)

The Relevance and Examination of Scientific Conditions[5]
– The analysis of conditioning factors (the focus on the causes and consequences shaping existential phenomena)

The Relevance and Salience of Projection of Future Developments[6]
– The projection of future developments (the relevance of predictive forecasting)

The Relevance and Consideration of Alternative Basic Policies in the Production and Distribution of Values (Creative Thinking)[7]
– The invention, evaluation and choice of value priorities and alternatives

I. It will be apparent that problem identification and problem solving are crucial features of the future of higher education. Creativity is a major challenge to conventional higher education with its focus on disciplinary autonomy. Creativity seeks to advance knowledge and understanding across disciplinary lines and fearlessly embracing new paradigms of knowledge creation, and the social responsibility for innovation.

II. The fundamental question that we now pose is: What is higher education for?

III. The answer is that higher education is for the defense and promotion of the basic values that are crucial to the well-being of the individual and all members of society. A major emphasis of higher education is the reproduction of shared enlightenment on the most inclusive scale that is institutionally possible. Enlightenment of course means the generation of new knowledge as well as the responsibility for how new knowledge is transmitted under conditions that sustain high ethical and moral standards of responsibility. As Einstein once suggested, new knowledge should be a blessing and not a curse to humankind. New knowledge also implicates the fundamental values inherent in the autonomy of the university as well as the salience of academic and intellectual freedom. This of course does not tell us precisely what the values are, how they are to be ascertained and clarified and how we are to secure and advance rational choices directly concerned with problem solving that improve the individual and aggregate value positions.

IV. One of the important insights about values and human beings is that all human beings participate in social process and are asserters of value demands which they need to survive to improve their life situation and to contribute in general to aggregate social well-being. Thus, human beings are not in a position of trying to find their values, they already have them. But their understanding of how these values are given content and operational salience is more complex.

V. *"The very act of posing the question in general terms about the importance of values is an indicator that the person posing the question comes with ideological beliefs that may characterize the particular social context."*

Struggling with this problem may explain why dramatic shifts in value orientation are rather unusual. A change in value orientation may be the result of being exposed to a wide range of conflicting social configurations. Such configurations may generate deep internal conflict in the personality. One such example is Gautama Buddha's transformation from a conspicuous and wealthy prince to a Guru of deep contemplation and teaching. In general, students in higher education may also be confronted with new configurations, which re-shape their value orientations. Rapid advances in knowledge and technology generation intensify the challenge of sustaining a value orientation or changing it among the participators in higher education.

VI. Higher education will challenge personal beliefs and generate value conflicts and intensify searches for both value content and value procedure.

4. The Problem of the "is" and the "ought"

I. The fundamental problem concerning the content and clarification of values is the determination of why a value should be preferred and given high deference over other values. In effect, this is a search for understanding the truth of a value proposition. Technically speaking, the method used by philosophers is that a value is entitled to its currency as a value when it is justified by reasons external to the statement maker. Even with this it is difficult if not impossible to adequately justify statements of higher general preference like the deference to be given to the principle of human dignity. In this sense the justification of values by transcendent religious experience can sometimes be a strut to support the human dignity principle. But, justification by divine rule, or some other trans-empirical source does not provide an objective validation of the principle. In this context, a statement maker proposing value and relying on divine revelation has a burden of objectively proving the divine source of the value.

II. To overcome the problem posed by the "is" versus the "ought" WAAS theorists provided a clarification not only of thinking in terms of the "is" and the "ought" but also other forms of thinking such as trend thinking, futuristic thinking and creative thinking. Since five different modes of thinking are required to understand and solve value problems, the problem solver has to integrate the five intellectual tasks generated for problem solving. With the guidance of these procedures, the gap between the "is" and the "ought" is avoided by the relevance of human choice and decision making. In short, the "is" and the "ought" and other methods of problem solving are crucial to the enhancement of rational choices in the interest of the individual self-system and the common interest of the community as a whole.

III. This has left theorists to postulate the principle of human dignity as the overriding goal value that should direct the future of higher education. The challenge to this approach is that postulation may be used in an arbitrary sense as well. However, pragmatic theorists have argued that since human dignity is a relatively self-evident postulation, it can serve as a guide to the teaching and the generation of knowledge in higher education circles. By making the postulate explicit, the postulate may be subject to criticisms as part of rational debate. In the absence of compelling critiques, the human dignity value should continue to guide and direct the future of higher education in terms of shared enlightenment, teaching, research and responsibility. If we assume that shared enlightenment is an aspect of the human dignity general principle, we are still challenged to delineate what it specifically means as a contextual reality in the context of higher education.

5. Shared Enlightenment and the Future of Higher Education

Since shared enlightenment is a component of the social process, it will be very important to know the specific context of conditions and factors within which the problems and the potentialities of shared enlightenment occur. To contextualize this process requires an identification of the critical dimensions of contextual reality in the context of higher education. What follows is a brief summary:

- Contextual reality related to shared enlightenment must identify the participators and are challenged to determine the level of inclusivity of participation.
- Participation happens in situations and these situations may be brick and mortar or virtual. Situations may be vital to a realistic understanding of realizing the goal of inclusive participation.
- Enlightenment may serve as a basis of power to increase the shared level of enlightenment. Enlightenment in scientific research and other technological developments may significantly increase the influence of the institutions of enlightenment. Indeed, specialized knowledge, access to grants, review of new knowledge are all laced with issues of enlightenment as a base of power.
- The fundamental issue of strategies is that enlightenment favors strategies that promote the growth and dissemination of knowledge.
- The outcomes of shared enlightenment in general favor the accumulation, storage and retrieval of valid information. The enlightenment preference favors inquiry into fundamental knowledge of man and nature and a complete exploration of the creative potentials of the human person.

6. Specification of Values

I. This facilitates a clarification of the general context of deferred value.

II. The next task is the specification of the values implicated in the human dignity principle. From a scientific point of view, specification of values involves a synthesis of definitional or syntactic specification as well as an exercise in semantic specification.

In this paper we do not stress semantics and syntactics in the specification of values because there is a long tradition of this as a conventional approach to the problem in both religion and philosophy. Syntactics and semantics implicate a method or exposition that has been described as derivation. To a large extent, derivation has a starting point in the existence of a god or some other Trans-empirical source. The traditions include Confucianism, Buddhism, Catholicism, Calvinism, German Idealism and Dialectical Materialism.

7. The Rise of the Individual, Human Rights and Higher Education Values

I. The role of the individual as a transformative agent in society and the demand by individuals are essential to the development of human rights. It is suggested that human rights emerge out of struggle in social process at all levels. That struggle is the struggle for the recognition of basic rights and essential dignity. Additionally, an essential linkage is made between rights and opportunities, and insists that values require processes to secure the satisfaction of human wants and needs.

II. The founding of the World Academy of Art and Science was inspired by a conviction that knowledge and technology alone are an insufficient basis for human development, unless guided by and subordinated to the pursuit of universal values inclusive of all humanity. The founders were cognizant of the challenges of complexity and interdependence consequent on the increasing flow of goods, services and people resulting from rapid globalization. They recognized that rapid social evolution was undermining traditional notions of sovereignty, giving rise to new conceptions of global responsibility and human rights. Concerned about the social consequences and policy implications of these radical changes, they searched for new principles of global governance based on the common interests and rights of all humanity. The current crises confronting humanity today reinforce the importance of global values as the essential basis for global social progress. Unregulated markets that serve the few at the expense of the many, undemocratic institutions of global governance, rising levels of inequality, unsustainable exploitation and destruction of our natural resource base, rising alienation of human capital from productive employment and rising levels of social instability are signs of a social fabric increasingly divorced from and insensitive to the welfare and well-being of large sections of humanity. At the root of the multiple crises confronting humanity today is a crisis of values that must be resolved before there can be any hope of lasting solutions to the problems facing humanity.

III. Concurrently, we are compelled to recognize the enormous progress humanity has made over the past few centuries in enhancing the values by which we live—the unprecedented freedom consequent of the expansion of democratic forms of governance, the unprecedented security resulting from rising levels of economic development, the greater recognition and enforcement of human rights, the gradual emergence of principles of a global rule of law and justice governing relations between nations and global society, which until recently dominated almost exclusively by power politics and military power. Each of these changes is partial and certainly incomplete, but the direction is evident and the will for progress still growing. Thus, we must reconcile our growing sense of dissatisfaction with the absence of values with a perception of their increasing importance. Jasjit Singh attributes this paradox to the fact that aspirations and expectations are rising faster than ground level social realities. The concern for global values, their meaning, and salience have also been a concern for the Club of Rome (CoR). The Club‘s own interests in rational global economic policy and practice in the common interest represent a challenge to it to better understand what the common interest actually is and what it implicates. Both WAAS and CoR have felt a compelling need for a deeper and wider transdisciplinary inquiry into fundamental questions relating to the values in the global system. Such an inquiry is essential for understanding the present state of the world order to which we have arrived as well as for charting a better collective future for humanity based on universal values for sustaining a world order in the common interest. Over the past two years, the World Academy and the Club of Rome have been exploring the root causes of the crises facing humanity relating to

the international financial crisis, unemployment, growing inequality, ecological destruction, global governance, international security and social stability. It soon became evident that the problems we face are rooted in the ideas and values that underpin the current global system, and the effective lasting solutions to these problems will require fundamental changes in the normative foundations of global society in the 21st century. In order to validate this premise, the Club of Rome convened an eclectic group of 18 individuals from diverse cultural, intellectual and moral frameworks to participate in a two-day workshop in Bristol, UK conducted in association with the Alliance of Religions and Conservation (ARC) to reflect on the impact of myth, narrative and values on social evolution and to provide insights into the values needed by the global community to support constructive development of all humanity in an increasingly cross-cultural, value/pluralistic world. The group included four Fellows of the Academy, including the lead author. Following two days of very stimulating creative discussion, participants were requested to submit answers to the following questions summarizing their insights into the role of values and narrative in the past, present and future development of global society.

- What are the key stories that have brought us to where we are culturally today and, which have been creative and which problematic?
- What do you see as being the key values that could shape the future and where would they come from?
- Which value, e.g. Liberty; equality; compassion—is the crucial one for you? Could you do a brief piece on both why and also on how it has changed its meaning in the last couple of hundred years?
- Going back to your roots, what were the key stories and values that shaped you? How have these changed and how have they, and do they, shape the present?

IV. These questions produced a number of wide-ranging responses reflecting the professional and cultural diversification of the group. Since the World Academy currently has a major emphasis on Individuality, our initial contribution provided a perspective of the Academy which focused on the evolution of individuality and its implications for the values fundamental to the global social process. We summarize the central points that we submitted stressing the evolution of a narrative of individuality from a global perspective. In this regard, we suggested that the present is on a trajectory launched far in the past and moving well into the future. To know where we are going, we must first understand where we have come from and how we have arrived at the present. Viewing the past few centuries in the light of four value-based narratives offers important insights regarding humanity's recent achievements, current problems and future challenges.

8. The Individual and Contemporary Conceptions of Human Rights and Human Justice

The role of the individual in the theory of human rights and justice, is reflected in the recent work of Ronald Dworkin.[8] Dworkin starts with the relationship of ethics and morality to individual action and responsibility. The ethical question for the individual is "what does it take for a life to go well?" This ethical principle is a focus on the nature of self-respect. Self-respect requires that the individual takes his own life seriously and appreciates that it is ethically important to make one's life a successful experience rather than a wasted opportunity. This principle therefore reinforces the individual responsibility for self-respect and authenticity. The individual must be self-aware of the ethical responsibility to identify what counts in life as a success. The moral principle, which is derived from this, and which has global implications, is, if my ethical principle of self-respect is important to a life that it is not a wasted opportunity, then that is a principle that I can support with regard to all non-self others on the planet; in short, a principle of morality and justice for all of humanity. Both of these theories of justice root the essential dynamism of it in the individual as a starting point. There is a recognition, therefore, that the individual, in taking responsibility for a successful life, is essentially a transformative agent in the social process. For Amartya Sen, individuals have capabilities which they should recognize and the need for the demand for opportunity to fulfill those capabilities. Dworkin frames the issue slightly differently but in a way that is not incompatible with Sen. According to Dworkin, "we need a statement of what we should take our personal goals to be that fits with and justifies our sense of what obligations and duties and responsibilities we have to others… Dworkin also requires capability and process freedoms, if life is not to be a 'wasted opportunity.' There is a genius in joining opportunity and capability with a responsibility to take one's life seriously as an aspect of both personal and community morality. The idea that each individual has a right to a life of self-respect and authenticity—which must be given operational effect by capability and opportunity freedoms—moves from that of an ethical commitment to that of a moral principle, in the sense that self-respect, authenticity, capability and opportunity freedoms are encapsulated in the universal principle of human dignity. Dynamism is rooted in the responsibility and obligation of the person to respect oneself. Such respect is sustained by the idea that the self is truthful to the self and, therefore, expresses to the self its self-validating authenticity. This means that the subjects of the idea of justice are meant to be active participants in the shaping and sharing of justice, and, moreover, to be active participants in the transformational dynamics of the principle of justice."[9] These views about the essential relationship between human rights values and the idea of justice effectually require the individual human being to be a subject of justice and a stakeholder in the promotion of the idea of justice implied in the fundamental human rights values. These insights are important matters for any discussion of the future of higher education and the values that it ought to promote and defend.

9. The International Bill of Rights: Global Values and Higher Education

1. Broad agreement exists about production and distribution of the core values in the UDHR and these values implicate both individuals and aggregates.

2. The values in the human rights framework cover both the so-called "negative" rights that purport to limit the abuse of power and the "affirmative" rights that implicate more directly the guidelines of responsible social change. Expectations in this latter category are styled "aspirational" rights.
3. While the word "universal" in the UDHR cannot be taken too literally, the nature of the rights in the Declaration has a more generalized character, a kind of "practical" universality.
4. The operative sphere of human rights is the socio-political conditions of interdependence and inter-determination. This means that rights are frequently "absolute," when they are contextually prescribed and applied. A cruder version of this point is the simple dictum that A's right or entitlement ends where B's like right or entitlement begins.
5. Human rights frequently give empirical specification to basic or fundamental interests. The approach to value clarification that we have outlined above may be usefully compared to the UDHR. The UDHR has been said to encapsulate three distinct generations of human rights: "first generation" civil and political rights; "second generation" economic, cultural, and social rights; and "third generation" solidarity rights. This common approach is stated in general terms. Since the rights are interdependent, this is not an approach which we value; nevertheless, the approach is conventional wisdom. First generation rights are represented in Articles 2-21; second generation rights are represented in Articles 22-27; and the third generation of solidarity rights are said to be represented in Article 28.

The second generation rights are the ones most controversial to constitution-makers, and the solidarity rights, with their transnational internationalist implications, may also be seen as far afield from conventional frames of constitutional law discourse. The rights expressed in Article 28, viz. that "everyone is entitled to a social and international order in which the rights set forth in this Declaration can be fully realized" has been developed in various international law influencing fora to refer to a more equitable distribution of global resources, the right of all nations to political, economic, social, and cultural self-determination, and "the right to economic and social development." Additionally, the right to a viable ecosystem, the right to peace, and the right to humanitarian aid during emergencies are also reflected in Article 28's mandate. This bare outline of the fundamental values attending the contemporary conception of human rights obscures a great deal of complexity, historical understanding, the pervasive and critical importance of normative insight in human experience, as well as the impact of science and change upon the human prospect. In short, human rights may have been influenced by trans-empirical or spiritual values, but its modern genesis is rooted in human experience. The human rights codes are actually given life and dynamism by the human element. We may describe this element as the element of dynamic humanism. The human element in dynamic humanism is the element of individual and associational choice. In short, human rights, as an aspect of dynamic humanism, are given momentum and relevance by the processes of human decision making. To illustrate this point with a specific example we may refer to the Polish Lawyer Rafael Lemkin. Lemkin had an intelligence predicate for the scope of the Nazi atrocities and proceeded to dedicate himself to the creation of a universal crime of genocide. The term 'genocide' is a neologism which he coined. However, the process of getting an international agreement on the idea of a universal crime for a major human rights violation encountered considerable resistance. It is possible that the leaders of sovereign states understood that the defendants in such a situation would be the state decision makers themselves. In any event, Lemkin's tenacity in pursuing the creation of the international crime of genocide is an inspiring example of the success of individual activism in the success generated by the adoption of the Convention that outlaws genocide. Indeed, we do not believe that we would have had the universal, international crime of genocide without the humanistic advocacy of Lemkin. Additionally, the seeds that would ultimately emerge from this initiative may well be the inspiration for the creation of the International Criminal Court. Today, we have countless illustrations of organizations which mobilized ordinary citizens' concern, activism and the corresponding influences on decision making with regard to human rights issues in all parts of the planet. For example, recent studies have shown that the global anti-apartheid movement was largely inspired by ordinary people's activism which in turn forced their governments to take stronger action against the apartheid state and which was a significant factor in the transformation of that country into a new political order. Similarly, tremendous indecision in the international community regarding the scale of atrocities of the conflict in South East Europe also generated citizen advocacy to reshape the dynamics of international intervention in that region. More than that, it was again citizen advocacy that led to the creation of the ad hoc tribunals for former Yugoslavia and Rwanda. Today, civil society, human rights organizations operate with global reach and are one of the most important sources of human rights intelligence. These organizations, directly or indirectly, train citizen investigators, citizen reporters, citizen advocates and citizens as human rights transformational agents. Moreover, such organizations have been skilled in utilizing modern technologies to strengthen global human rights mobilization. For example, Amnesty International has a sophisticated urgent action network, which permits it to have instant communication with thousands of members who focus on urgent human rights actions. This can be expeditiously done because of the speed with which a crisis can be communicated worldwide and generate an equally expeditious response.

10. Human Rights: The Social and Psychological Sciences and the Specification of Basic Values of Importance to the Future of Higher Education

I. Values today generate a discourse that is at times intellectually confusing, and critics might even suggest that it generates incoherence. It is therefore important to get to the basics of what we mean by social process, the role of values and social process and the challenge to social process of creating a constructive public order significantly influenced by the process of shared enlightenment generated from the processes of higher education.

II. Early in the last century the great anthropologist Malinowski conducted observer participant studies in islands in the Pacific. Among his publications was a famous book "Crime and Custom in a Savage Society". What Malinowski identified in terms of operational rules and customs in the community was the linkage of these rules and customs to the existential needs of community member participants. Later, the British anthropologist Radcliffe Brown connected the notion of community needs to community institutions, that with whatever efficacy were specialized to realizing these needs. After the war, Lasswell and his associates began to re-conceptualize the notion of needs in terms of values that human beings sought in their social interaction in community with other human beings. Thus, they merged the idea that social process comprises human beings in pursuit of desired values in the community for the satisfaction of human needs and human aspirations. The critical task of the social scientists was the identification of values, the identification of institutions and to determine how well or poorly values were secured and distributed in the community. With the publication and adoption of the Universal Declaration of Human Rights, value analysis became much more explicit and identifiable as correspondingly with institutions specialized to the securing, realizing and distribution of the basic values in any social process. The breakthrough for social theory emerged with an elegant description of social process, almost the equivalent of Einstein's $E=MC^2$. Social process is a process of social interaction between human beings and community. This process of interaction involves human beings seeking to secure basic values, through institutions based on resources. The human personality is thus a demander of values, and an activist in pursuit of values. This places the human being, and human subjectivities and perspectives at the center of the social process be it local or global. To complement these insights the psychologist Maslow created a hierarchy of human needs:

- Physiological – hunger, thirst, bodily comforts, warmth
- Safety/Security – out of danger, order, law, stability
- Belongingness and love – affiliate with others, be accepted
- Esteem – to achieve, be competent, gain approval and recognition
- Self-Actualization – realizing personal potential, self-fulfillment, seeking personal growth and peak experiences

11. Values and Social Process

The central importance of values to policy-making is highlighted by a perspective which recognizes values as one essential element in an integrated social process, as described by Lasswell and McDougal. To give values a foundation of social realism, we may describe the Global Social Process as comprising the following:

Social Process = People + Values + Institutions + Resources

Lasswell postulated eight fundamental values driving the social process:

1. Power – The making of decisions enforceable by severe deprivations or high indulgences; making and influencing community decisions.
2. Enlightenment – gathering, processing and disseminating information and knowledge.
3. Respect – Freedom of choice, equality and recognition.
4. Well-Being – Safety, health and comfort.
5. Wealth – Production, distribution and consumption of goods and services; control of resources.
6. Skill – Acquisition and exercise of capabilities in vocations, professions, and the arts.
7. Affection – Intimacy, friendship, loyalty, positive sentiments.
8. Rectitude – Participation in forming and applying norms of responsible conduct.

The above approach may have some value for this discourse because it comes in a form directly related to the policy-making arenas of concern to the World Academy of Art and Science and the Club of Rome. The approach outlined above provides us with eight value categories and provides us with a marker, which targets the institutions that control and regulate the production and distribution of these values. It has an added element, namely, that rather than isolating economics from society and social realism, shows that economics can influence every other value, and every other value may have an influence on economics. That is an important insight for the CoR. Second, the values identified here are the values that had emerged from the secular give and take of global politics. These values have extraordinary traction, although in the area of economics this has not been widely recognized in recent decades due to the strenuous but failed attempt of neoliberal economics to mimic the objectivity of natural sciences. According to this perspective, human beings do not invent values; we simply present the formula or the relevant myth and the accompanying narrative relevant to our time. The importance of the categories of values is their clear connection to identifiable institutions whose efficacy may well be questionable at this time. This approach provides a pointer to focus on critical inquiry into institutions crucial to human progress, and with a possibility of recommending reform or improvement.

We now extrapolate on the value scheme implicated in human rights and of vital importance to higher education. In this we should recognize that shared educational and enlightenment values, which are at the heart of higher education are one of the most important bases of power for bringing science, reason, wisdom and deep understanding to the political culture of any community. The following is the current value scheme:

1. **The value of life**: This is a centrally valued human subjectivity. It is referred to not in the "pro-life" sense (that a pregnant woman must bear a child), but in the Bill of Rights sense (that a person has the right to personhood and autonomy). The value of life, therefore, includes the respect and deference given to the individual in the global community.
2. The status of the value of **power and security**: Should it be narrowly or widely shared? Is the common interest of all honored in a system that seeks to secure the widest possible participation in all key areas the power process? One of the central values identified in the Atlantic Charter was the freedom from fear. This concern for freedom has evolved so that today no one denies that there is a critical interdependence between the concept of peace as a human right and all the other values in the UDHR. Peace and security might well be included under the functional category of power. However, peace is recognized as a complex peremptory component of the human rights value system. It is of value to again recognize that there are complex ways in which all human rights values have an influence on peace and security, recognizing as well that peace and security at all levels are critical conditions for the effective mobilization of human rights values. A central aspect of the values of peace and security relates to the connection between the mobilizing force of strategy for the realization of human rights goals and the realization of these goals themselves. For example, is it appropriate to deploy violent strategies of action to achieve human rights objectives? Is it appropriate to disengage the value discourse involving strategy and struggle on the one hand and idealistic value objectives on the other hand? Gandhi, for one, insisted that the morality of struggle was even more important than the morality of distant idealistic objectives. Indeed, he also insisted that a disconnect between struggle, strategy, and goals was morally indefensible.
3. The **status and value of economic and wealth processes**: Is the common interest of all better secured by optimizing the capacity to produce and distribute wealth or the opposite?
4. The status and value of **respect and equalitarian values**: Should invidious discrimination be fully prohibited (covering all areas of race, gender, alienage, etc.)? Can equality be meaningful if it is only a formal, juridical idea without regard to the legacy of exploitation, repression, and discrimination?
5. The status and value of **educational and enlightened values**: Should these values be widely produced and distributed or narrowly experienced?
6. The status and value of **skill and labor values**: The centrality of labor and skills values to the human condition indicates that these are central and fundamental values implicated in the rights and expectations of those who seek to create and sustain these rights and labor values. Should these rights and expectations be widely shaped or narrowly shared?
7. The status and value of **health and well-being values**: The delivery of reasonably formulated and accessible healthcare and social services to all is now widely regarded as crucial entitlements, if the most basic standards of decency in politics and society are valued. Today, unemployment aid, social security, medicare, and other social services are considered crucial to a society that cares for its people.
8. The status and value of the **family and other affective values**: Because the family is the basis of collective existence and is central to the human rights of children, the public policies of a society that destroys family (and other affective ties) pose a problem for the wide generation of affective values including the loyalty values of patriotic deference.
9. The status and **value of moral experience and rectitude:** A system that endorses the centrality of moral experience to the legal and political culture and seeks to maximize the spiritual freedom of all is yet another of the central themes of human rights.
10. How do we translate expectations of care or fundamental moral experience into the practical prescription of law and policy?
11. The status and value of cultural and aesthetic experience: The term 'cultural' includes the concept of the aesthetic. In fact, the word "cultural" could encompass all the value preferences that we might extract from the UDHR. There is, however, a narrower meaning that the term culture might carry. That meaning ties in with the notion of human rights as also emblematic of the diversity of human experience, experience that reflects the cultural richness of humanity as a global community. There is great controversy about the issue of culture and tradition, culture and creativity of the present, culture and the elaboration of the aesthetic, which may capture and nurture the cultural narrative of creativity and beauty which may in fact be the critical psychological view of how the glue of social solidarity promotes creativity. The boundaries of this discourse are controversial. Sensitive matters of sexual regulation which may differ widely may be justified by culture and yet here the culture of tradition may not be compatible with the culture and creativity of the present or the future in human rights terms. For example, female genital mutilation justified by cultural tradition is not justified by either religion or by the science of human sexuality. Human rights thus provide a process by which these boundaries may be appropriately protected and expanded according to the normative challenges of human dignity. The current discourse often suggests that universality trumps cultural relativity or vice versa. This is not necessarily helpful unless one sees these ideas as only the starting point for value clarification and application from a human rights perspective.
12. The status and **value of the eco-system**: Today, we recognize a complex right to a viable eco-system on what theorists have seen as Spaceship Earth. The values embedded in the protection and promotion of a healthy eco-system, are, like many other values, issues of complex inter-dependence and inter-determination. However, implicit at least, in the concern for the integrity of the eco-system is clearly the notion that there are no human rights if there is no environment in which human beings can survive and possibly even improve the human prospect. But this insight suggests an even higher level of moral consciousness in the sense that the eco-system (with its plant life and animals, wild and domesticated) is part of a complex cycle, in which

human beings are both custodians and also utterly dependent as individuals and as society. This means that we now see in nature not something irresponsibly exploited and destroyed but central to our identity as a sentient species. To take a simple example, for all the vaunted technology of human progress and human egotism, no one has seen a dog or a cat or a rat or indeed the most elemental of recognizable life forms outside of this lonely and unremarkable planet called Earth. Thus, as humanity, we now look at life even in its most humble forms as not only indispensable to the interconnected chain of life on this planet but we see in it something new and utterly connected to the very consciousness of being human and being alive. In short, we know that our dogs identify with us. We may now know those ordinary pets in terms of how they and all other living forms have shaped our identity both psychologically and physiologically.

12. Human Rights Values as a Dynamic Humanistic Challenge for Dignity in the Future of Higher Education

Human Rights as a Dynamic Humanistic Struggle for Dignity in setting out the issues and problems that limit the scope of contributions that academics can make to the human rights agenda, the core ingredients of a solution to the dilemma can be identified. The solution requires a theory for inquiry about human rights. The theory must have a decision-making focus to have practical relevance, since only effective decision making—formal or informal—will apply human rights perspectives and operations to particular situations and contribute to a human rights-conditioned future.

A theory about human rights, that is policy decision-focused, must self-consciously concern itself with the policy process itself by integrating actual human rights problems that require policy responses; both the problems and the decisional responses to them must occur in a disciplined contextual setting and the decisional responses must employ processes that meaningfully clarify the policy basis of human rights prescriptions. Theoretical inquiry about this kind of emphasis must embrace cross-disciplinary tools of inquiry, or multiple methods, to give scientific credibility to the enterprise. This requires fidelity to at least four essential features of a theory about human rights inquiry from a humanistic policy perspective;

1. **Comprehensive mapping**: Fundamental to an inquiry is the expression of a comprehensive map of value problems specified in terms of functional value categories and which permit continuing refinement and elaboration. A systematic expression of these problems will underline the difference between value deprivation and human rights realization. The lexical formulation of human rights as rights is frequently the tail end of a process that needs illumination.

2. **Relevance of context**: Factual, theoretical, historical, and political contextual relevance must drive the theory. All human rights, in the sense of process, must be seen in relation to every relevant community context, from local to global.

3. **Relevance of advocacy, policy and decision**: These are matters alien to academic culture. The focus on policy and decision requires the identification of past, present, and future decisional mechanisms at every level of community that may be relevant in clarifying, specifying, protecting, and enhancing human rights. We should of course keep in mind that policy and decision do not function in a vacuum. Frequently what triggers a policy response is a problem that emerges from the social process context. That problem will emerge in the form of a dynamic humanistic claim for a human rights value and an aspect of social process that will respond by resisting that claim. Therefore, the quality and sustainability of interest articulation and advocacy will be an important foundation for a response that is authoritative and controlling to the problem that is eventually presented for decision. These areas are crucial to the responsible exercise of higher education tasks.

4. **Relevance of key intellectual tasks for inquiry**: The relevance of the identification and use of appropriate intellectual tools is necessary to clarify the rational, theoretical and factual basis of the context of human rights, as well as the procedures for their realization in fact. The key discrete intellectual tasks are; goal and value clarification; the historic study of relevant trends; the scientific study of causes and consequences of human rights failures or successes; the concern for predicting possible future scenarios in terms of approximation to desired human rights goals; and the creation of alternatives to better approximate the desired human rights goals.

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Online and Hybrid Learning

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"This has caught all of us by surprise," said David Stavens, co-founder of the educational organization Udacity, when he saw the overwhelming response to one of the first Massive Open Online Courses in 2011. Since then, MOOCs have continued to surprise, excite, empower, disrupt and unsettle the education paradigm. Inspired by The Khan Academy, Stanford University Professor Sebastian Thrun decided to make his course on Artificial Intelligence available online, expecting a few thousand people to show interest. 160,000 students signed up. They came from 190 countries, their ages ranging from 10 to 70! This triggered a revolution in global online higher education. Thrun founded Udacity, and this was followed by the founding of a number of other MOOC providers, and 2012 came to be called by *The New York Times* as the Year of the MOOC. NY Times columnist Thomas Friedman declared of the MOOC that "nothing has more potential to lift more people out of poverty."

Distance education is centuries old. The Boston Gazette carried an advertisement for short hand course through lessons mailed weekly by post in 1728. The University of London offered its first distance learning degree in 1858. The 20th century saw the founding of Open Universities worldwide, the largest being the Indira Gandhi National Open University in India, with 4 million students. Radio and television began to be used to complement learning. Then computers and the internet helped disseminate information widely. In 2001, MIT launched the OpenCourseWare project and made digital notes, homework assignments and lecture videos available online. The improvements in information & communications technology and the decrease in cost of internet access came at a time when education was ripe for transformation, and the advent of the MOOC was the fall of the Berlin Wall in education!

As of 2017, the top three MOOC platforms had between them 38 million users and offered over 3000 courses in multiple languages, free, certified, on-demand, and with college credits. Some of the MOOC students are full-time university students, graduates and professionals. Others enrol in MOOCs because they are interested in the subject, wish to acquire a new skill, or pursue a passion. For many, the MOOC is their only access to quality education and hope for a better future.

MOOCs started as recordings of classroom lectures. Gradually other features were added—images, charts, animation, videos, interviews, interactive tests, assignments. Typically, each lecture is around 10 minutes, and the entire course spread over a week to a few months. Some lecture recordings include a live audience; some courses have multiple teachers or guest lectures by subject experts. Notes are provided, study material and books recommended. Online discussion forums, social media platforms and physical meetups provide human interaction. Some courses require the completion of a small scale project. All those who complete the course and meet its requirements with regard to assignments and tests are issued certificates of completion. Most courses are open and free. However, for a fee that varies from course to course, students can submit proof of their identity, have their course-taking authenticated, and receive a verified certificate. The identity verification process can also include students taking proctored examinations in supervised testing centers or attending live video interviews. Some verified certificates carry college credits that can be transferred to a university. Some MOOCs also offer university-recognized online degrees. There are also paid online courses that come with a job guarantee.

The benefits of online education are enormous. They are free and open to all. Anyone anywhere in the world with an internet connection and a phone, tab or computer can learn. They are flexible and self-paced. People can make their education fit their schedule. Students can audit and sample topics online to see what they like best, and take a studied decision in selecting their college course. Online classes are scalable to an extent that is impossible in the brick and mortar set-up. A classroom of 10 students can be expanded to take in millions, by making some technical adjustments. The syllabi can be revised and updated continuously. Content is co-created and the classroom becomes global. Anyone who can teach well and knows the subject can offer learning content. So this model is democratic not only in the way it allows anyone to learn. It offers a level playing ground for all who wish to teach from individuals to universities. The internet allows for the creation of a common pool of resources that anyone can contribute to and benefit from. The teachings of the most brilliant and creative minds can be collected and stored for all future. In a future that will see a majority of existing jobs disappear and knowledge becoming outdated rapidly, life-long learning is mandatory, and online courses make this possible. The complex interrelated challenges that we face require a comprehensive knowledge of the whole. Transdisciplinary education is facilitated by MOOCs and other open educational resources.

College Board, an American association of over 6000 educational organizations, conducts the College Level Examination Program (CLEP) that assesses college-level knowledge in various subjects, and provides a way for earning college credits without taking traditional college courses. About 2900 colleges recognize CLEP credits. Self-taught or homeschooled youngsters can learn from MOOCs, demonstrate their proficiency with CLEP, and thus bypass undergraduate coursework and join mainstream education. Students of open universities and long distance education too can supplement their course materials with MOOC content.

Online education has great potential, but its challenges are equally immense. Personal attention and human contact are mostly missing. A lecturer personally assessing student progress or evaluating assignments is impossible in classes that have students ranging from a few thousands to over a million. At best, tests with multiple choice questions and computerized correction are possible. But this does not work for all subjects. Cheating is easy, prevalent and hard to detect. The levels of standardization and acceptance are low in the case of online credentials. Course completion rates range from 10%-25%. Some subjects and courses like

medical education need hands-on training that cannot be replaced digitally. Most online resources are in English, and the language and the culture associated with them are seen to spread, often at the cost of other languages and cultures. Online learning heightens our already increasing dependence on gadgets. Physical person to person interaction is reduced.

The flipped classroom model, in which students view recorded lectures and course videos at home and use the time in the classroom for discussion and interaction, is a much more effective use of the time spent in the class. All the time taken up in the classroom lecture can be used more productively this way. Such a combination of online and traditional learning—Hybrid learning—makes the best use of both models.

The hyped up predictions of online courses replacing colleges and digital badges making university degrees redundant have, if not been proven incorrect, at least not yet happened. But a phenomenon that is a few years old cannot be compared to organizations that have existed for centuries. Online learning is a silent revolution. People in refugee camps in Asia try to compensate for the disruption in their lives and their education with the help of MOOCs. Medical assistants in health camps in Africa learn to handle epidemics from online learning resources. Youngsters who cannot afford a university degree choose this alternative. Employees who look to improve their skills or switch careers take advantage of digital badges and certificates. Employers implement corporate training through existing or specially customized MOOCs. They also recruit students on the basis of their online certificates. Classrooms in schools and colleges use the flipped learning model and improve the effectivity of learning. Universities are partnering with MOOC providers and offering their courses to the world. They are transforming or are trying to transform themselves by embracing their core strengths with the power of online learning.

If we are to radically improve education quality and make it accessible to all in the shortest time possible, it can only be done by leveraging the potential of online education. Online and Hybrid Learning are some of the best tools to bring about a paradigm change in future education.

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Revisiting our Evolutionary Path: The Search for Holistic Education in a Fragmented World

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Abstract

When the World Academy of Art & Science (WAAS) was founded, it sought to address the gap between science and society, or rather the apparent unwillingness or inability of scientists to address their responsibilities as important members of society. This problem is related to the growing disparity between tool making and symbol making, those ancient skills that brought humans to the highest stage in the evolutionary process (at least until now?). Symbols—language, mathematics, graphics and other pictorial and linguistic representations, as well as clothing, hairstyles, etc.—when used to establish social rank, may serve to give legitimacy to the current social order or may serve to criticize and change it. Reincorporating science into society would require that scientists, as well as every member of society, recognize this. This would require an educational system that would give equal emphasis to tool making and symbol making, and this would help students to understand how society is a product of both of these processes.

> *[Professor X] was a mathematician who liked to think of himself as a philosopher, though this was professionally dangerous to admit.*
>
> **– James Gleick,** *Chaos: Making a New Science***,** p. 65

1. Introduction

James Gleick's comment shows just how far we have come from the Ancient Greek view of knowledge and education, from a culture in which philosophy was the beginning and end point of all learning, in which art and science were instruments in the quest to understand the meaning of life. We now must believe that science is the master of all knowledge and that philosophy and art are interesting hobbies for those so inclined, but not to be taken seriously as a real source of knowledge.

This is not to denigrate in any sense the enormous increase in knowledge, especially of the material world, provided by science over the years, especially since the Renaissance, but many observers of our current global culture are questioning whether there might have been a critical sacrifice of our spiritual being along the way to this material progress. Artists, especially writers and philosophers, have been asking this question for many years now, (Mishra 2017) but it was the eruption of protest in the sixties that illustrated how far into society this dilemma had reached. In 1968 alone, protests by young people extended from Beijing to Prague to Paris and Chicago, demonstrating that the political economic divisions between capitalism and communism were not the main issue. And these protests were not violent; they were not terrorist attacks on the system, though they brought forth substantial repression from the established centers of power in these varied social systems. Indeed, these were emotional and spiritual protests against the alienating impact of non-democratic control over the lives of everyday people provided by the extension of deterministic science and technology deep into our global culture. For example, as John Taylor Gatto (1990) had declared,

> *Schools [in the USA] were designed by Horace Mann and Barnard Sears and Harper of the University of Chicago and Thorndyke of Columbia Teachers College and some other men to be instruments of scientific management of a mass population. Schools are intended to produce through the application of formulae, formulaic human beings whose behavior can be predicted and controlled,*

and

> *Lives can be controlled by machine education but they will always fight back with weapons of social pathology—drugs, violence, self-destruction, indifference. . . [etc.]*

We may view science and technology as extensions of our tool-making capacity, something which archeologists and evolutionary biologists have given great importance to. But human beings are also symbol-making animals (Burke 1961, 1968a, 1968b, 1969a, 1969b), something, which, among other things, has also made the continued development of our tool-making capacity possible. Symbol making and using are much more than a means for facilitating the extension of technology, however. They are also very important in maintaining the social order, necessary for our survival. This is an aspect of education that has been neglected in our rush to improve our 'tools'.

2. Culture as Education

Education begins at birth. Its first stages are an introduction into one's culture. Culture is the ancient survival response of human beings to the physical and social environment in which we find ourselves. But it is not just a linear reaction because we ourselves have always participated in creating even our physical environment, as it appears to other species (Lewontin & Levins 2007). Culture is an attempt to formulate moral rules of behavior and the social roles to carry them out. This enables cooperation among individuals, which we Homo sapiens have long discovered is the means of survival in the Darwinian world in which we find ourselves. We have

done this as a result of our reasoning and our ever more sophisticated means of communication, something which has allowed us to switch our evolution in the food chain from prey to predator (Sussman 2008, Sahlins 2008).

Therefore, in order to explain human behavior it is necessary to understand the relationship between what we are thinking and what we are doing. This is something that anthropologists have always known, of course, since they have often been working in cultures different from their own where the taken-for-granted rules and roles were different from their own. The creation of culture is an ongoing process, not only for the individuals who are born into a culture but also for all of its members young and old. This is because of the fact that the social and physical environments are constantly changing. They are changing in large part owing to the changes in knowledge that a culture's members themselves create because of their human capacity to reason and communicate.

Science is a product of this dialectical process. It is the latest stage in the evolution of knowledge. Science has its own evolutionary trajectory, as Thomas Kuhn described in his classic study *The Structure of Scientific Revolutions.* This book was unsettling to many scientists as it upset their conventional view of science as an incremental, linear process of accumulated and verified knowledge. It was something of a cultural shock because it suggested that human beings not only discover but also create scientific knowledge, which is then subject to human misunderstandings and revision, making it not unlike other human endeavors to understand and act in the world. An astrophysicist friend suggested that scientists do indeed solve puzzles of nature, but in so doing they discover many more things that they do not know and in the process constantly expand the overall size of the puzzle.

This has had the result of shaking somewhat the almost religious-like belief in the certainty of scientific knowledge about nature. This may not be all bad because the effort to apply this belief with certainty to human society has had even more unsettling effects. In other words, science plays a social, symbolic role in culture. Science has been very successful in controlling nature and providing economic benefits to its users. As a result, it has gradually sought to assert itself as the only true source of knowledge about social reality similar to its role in understanding nature, ignoring the role played by alternative forms of human consciousness in organizing human behavior. Or rather one might say that society has allowed science to monopolize human consciousness so that the role of culture in organizing human cooperation would be defined only in scientific and engineering terms, ignoring art and philosophy as possible important contributors to this process.

Not that science has not and does not contribute to our knowledge about the human social order. It is simply that scientific knowledge about society is not an end in itself, as many scientists might appear to believe. It forms part of the moral and philosophical system that judges how to use this knowledge, i.e., that judges whether any existing social order should be maintained at any expense, a position usually held by the more privileged strata in any society, or should lead to changes, often the position held by the less privileged members in a society. Scientists and engineers proclaim themselves to be value-free. Yet they also have moral obligations. They are, especially as scientists, also members of society, and are not divorced from and/or above it. Most importantly, they must evaluate how and where their scientific knowledge is to be dispensed, especially the form in which this information is to be presented. This, of course, has nothing to do with the separate issue of their value-free stance in creating this knowledge. In the process of reflecting on the uses of the knowledge they create, they could learn to recognize both its symbolic and instrumental uses.

At the same time, positivist *social* scientists see no significant difference between society and nature and believe that the same epistemological and ontological assumptions can be applied to both. Thus, they use a sophisticated set of abstractions to communicate their theories and research findings. They do this in order to maintain their particular position in the social and/or professional 'food chain'. These sophisticated abstractions would, however, be quite inappropriate if these scientists were to believe that everyone should be informed about any current injustices and/or tipping points in the social system that could be corrected through structural changes. Such a belief would require a much simpler form of communication, not unlike one used by advertisers, for example. In other words, *there is a huge information gap between the highly specialized social and natural scientists and everyday citizens, which obstructs the exercise of democracy in the modern world*. Somehow a revised educational system must confront this issue, if culture is to evolve and keep up with our advanced tool-making capacity.

Scientists, in other words, especially social scientists, are key players in *constructing* social reality, given that they have an enhanced understanding of how society is formed and reformed through feedback about the consequences, intended and unintended, of everyone's actions in that society. How and to whom they communicate this understanding is not a value-free decision, or somebody else's problem, which is a common response by scientists and engineers in today's fragmented and highly specialized social world. It is everybody's problem, especially as it is now revealed in the newly perceived holistic world presented by systems theory, structuralism, complexity studies, quantum theory, chaos theory, etc., where everything is seen to be connected to everything else. This is an insight that appears to be generally more acceptable to women than to men, if current research on the brain is to be believed (Gutenschwager 2017).

A rising educational level, especially among women, may explain in large part the reasons behind the Cultural Revolution that began in earnest in the 1960s (Roszak 1995 [1969]). Many commentators on Roszak's book believe that this youthful revolution failed, perhaps because it was too idealistic. But cultural revolutions take a long time and their evolution into an organized and significant movement of people to change the world may take decades or even centuries. At present there is a substantial number of people who are 'revolting' by withdrawing, at least spiritually and morally, from modern society (Ray and Anderson 2000). These people, labeled by Ray & Anderson as 'Cultural Creatives', now (2008) amount to 70 million adults or a third of the adult population in the United States, with a likely similar number in Europe (Inglehart 1997). They were discovered quite by accident during many years of survey research and in-depth interviewing in the 1980s and 1990s, not only by Ray and Anderson but also by many other

researchers mentioned in their book. Many of the Cultural Creatives do also participate in active demonstrations against corporate efforts to dominate and rule the entire world through trade agreements, financial manipulations and the like. All of this gives witness to the continuing importance of the Cultural Revolution in today's society.

At the same time there is a growing awareness that the *uses* of science and technology are as important, if not more important, as the actual discoveries of science itself. Many scientists are not prepared to consider themselves to be a part of this process, believing it to be 'somebody else's problem': the political scientist's, the sociologist's or that of whomever, but not theirs. They confuse the effort to escape bias in their search for knowledge with the actual role played by that knowledge in society. Culture is the creation of rules and roles, something of concern to all members of society reached by those rules and roles. As the reach of science and technology has become more and more global, the process of creating modern culture now includes everyone on the planet.

It might help to consider two different ways that science may be understood in its application to society: as a deterministic endeavor or as a heuristic endeavor. The deterministic scientist believes that science allows us to discover the universal laws of nature, laws that control both living (including human) and non-living nature. In other words, for them, human behavior is not controlled by ever-changing human thought and intention, but by laws that are discovered by science and which therefore give to the scientist the privileged status of apparently knowing in advance what humans are going to do in the future, usually within some kind of evolutionary theoretical framework. The deterministic scientists are understandably indifferent to the social and moral implications of their findings; they bring certainty to an uncertain world. Since they attach no moral judgments to their scientific findings about society, they also enjoy all the social and material support of the ruling classes and thus, at the same time, fulfill their need for power, even if only vicariously (McClelland 1975). They are well within the ideological framework of modern society, a framework characterized by modern economics as some form of 'survival of the fittest', claiming, more or less, this as the proper scientific framework for understanding human society.

Heuristic scientists, on the other hand, believe that they are part of a collective philosophical effort not only to understand society but also to fulfill their moral obligations to make it a just and happy society as well. The word 'heuristic' derives from the Greek word "ευρίσκω", which means 'to find', and is also found in the English word "eureka". In the case of social science, heuristics can help society to reinforce philosophical ideas, such as those of Epicurus about the essence of happiness (Ypijakis 2013), or to understand better the meaning of Lord Acton's 1887 philosophical insight that "Power tends to corrupt, and absolute power corrupts absolutely" (Useem 2017, Owen and Davidson 2009). Science can also be used to discover often unanticipated consequences of intentional actions, using methodologies ranging from statistical analyses to mathematical model building. These findings do not suggest a deterministic social process but rather disclose important information that can be fed into a philosophical discussion and any consequent social and political decision-making process that seeks to avoid possible undesirable consequences. All of this is complicated by the unequal distribution of wealth and power, which may result in the withholding and/or distortion of scientific findings so that the democratic process is compromised. Thus all scientists play a crucial role in society with the power to expose important information to the public, but are sometimes at the risk of losing their financial and institutional support. Using a deterministic and/or value-free mask allows scientists to avoid this moral dilemma, though it does not disappear as a result, of course.

Unfortunately, we now have very few institutions for democratic participation at the global scale. In fact, every technological advance requires a period of years, if not decades or centuries, in order for culture to be reorganized to accommodate those advances. This was true of the technological innovations that allowed the domestication of plants and animals which produced the surplus of food necessary for urbanization to occur. It required hundreds of years before the Ancient Greeks were able to establish institutions for managing society at a new scale. Their cultural innovations are still part of our ideological tool kit today, even if they have become increasingly ineffective, as technology has increased the scale and complexity of society over the past several hundred years.

This can also be seen in Hugo Boyko's statement during the founding moments of the World Academy of Art and Science:

> *[Technology] is an example of how the tempestuous technical development tends to throw mankind off its psychological equilibrium and possibly to destroy it physically (Boyko 1961).*

In other words, the dialectic between consciousness and behavior that produces a culture is neither a mechanistic nor even a very efficient process. One reason for this is that those who benefit either materially or psychologically from a possibly outdated view of reality will use their executive powers to bias communication and forestall an awareness that would keep up with changes in the 'real' (material) world. It's also true that average people do not change their belief systems very easily, something that is true of scientists as well, as Kuhn demonstrated in his book. Such change often requires a profound effort, as belief systems are as much emotional as they are rational.

3. The Role of Science in Society

The actual role of social, and sometimes natural, science is not only to understand, but also to construct society. This can best be seen in the social science of economics. In order to present itself as a science, economics has had to make a series of normative assumptions that it never examines empirically, but takes for granted, as if everyone in the world already believed them to be true. The most glaring of these is the assumption that everyone pursuing his own selfish interests will produce the best common good. This may be proven mathematically but unfortunately not empirically, unless the empirical facts are so carefully chosen and/or doctored as to make it appear to be true. So much has been written about these and other shortcomings of economics as a social science that

it is hard to believe that it is still believed to be a creditable approach to understanding, let alone constructing human society, except somehow in a heuristic manner (Schumacher 2010 [1973], Harvey 2005, Magnuson 2007, Keen 2011, Quiggin 2010, Perelman 2011, Smith & Max-Neef 2011). Among other things, economists substitute the market for true democracy, perhaps because true democracy is so rarely seen, but also because democracy is a much more difficult and complex social phenomenon to study.

There are no human beings in economic theory except the caricature, the 'economic man'. Thus, there is no consciousness and there are no intentions outside of this normative formulation; there are only mechanistic causal relationships. Thus there is no way to judge anything in an economized society outside of monetary values; there are no moral values. Economics sees itself as a natural science trying to understand society, but without trying to understand human beings and how they actually construct society. Ordinary people do this with values that do, of course, include money, but actually also much more. Economics enters this process of helping to create culture with only its 'Homo economicus' vision of the human being. This vision it seeks to *impose* on society by persuading through symbolic techniques that this is the only proper way to view oneself and others in the Social Darwinian world we inhabit. It is a heartless, predatory world that economists have helped to construct, creating profound alienation that the Cultural Revolution is seeking to correct.

Economics, based on Newtonian physics, can be useful in pointing out the sometimes-unintended consequences of our intentional actions, especially those influenced by the normative presuppositions of economic theory. But this is not sufficient for providing moral guidelines, inadvertently perhaps, for human society, or for any other living system, for that matter. Increased wages, for example, do not result in speculation, but inequitable distribution of wealth does. Profits from speculation may be a necessary evil, not an indication of a healthy, productive economy. Economics, as we claim, is not an empirical science but rather an ideology that is active in constructing society by persuading people to act in specific ways, but without including any other moral values except greed and envy. Policy recommendations in this framework are not based on empirical science but rather on this ideology.

So why is economics so important in today's society, including in academia? It is supported because it plays an important *symbolic* role in legitimizing and justifying the position of the ruling class, a class that uses both technology and symbolic means to maintain its controlling position in the social hierarchy (Ryan 2017). Even other natural scientists are powerless to confront this symbolism, both because their education, absent philosophy, has ill prepared them to understand this problem, and because their very livelihood depends on not challenging this social hierarchy. This is true even though one may realize that the natural world itself is being destroyed as a result of the shortsighted understandings prevalent in the idea of the 'market' (Commoner 1966, 1972, 1990).

This is not to argue that economics should be eliminated as a holistic social science, simply, it should not govern and dominate the system of moral values on which the social system is constructed. It should constitute a heuristic science, offering insights on the likely consequences of various courses of action taken by social actors who might or might not subscribe to the current ideal of individual rationality and egocentrism.

One more recent holistic scientific effort to understand society is through the use of chaos theory. Chaos theory refers to non-linear dynamic systems, not unlike those referred to in earlier uses of systems theory. It has been very useful in explaining events in nature that do not lend themselves to explanation within the traditional Newtonian framework of reductionist, linear, and reversible mechanisms (Gleick 1987). Here a whole range of events in nature, such as sudden moves from order to disorder or its opposite, can be understood as a product of thresholds that move a system to a new state, otherwise unforeseeable in a simpler linear framework.

On the positive side, chaos theory, systems theory and complexity theory are very useful in shifting attention to a more holistic framework. They must also, however, like other efforts to apply natural science theory to society, arrive sooner or later at the same point at which economics has now become stalled, thus revealing their *social and symbolic* nature. In other words, they may be seen symbolically as ideology in the deterministic sense of the word. And this has to do with the role of consciousness in constructing the social world. Thus, any social finding established through the use of natural science methodologies will enter the consciousness of the members of society making it possible for them to change the initial conditions of the system, i.e., their thoughts and intentions, such that the outcome will be different from the prediction in any model, mathematical or otherwise. The Cultural Revolution we are (perhaps dimly) perceiving as going on in the world today is nothing more than an effort to change the initial conditions of the social world we inhabit.

4. Education for a Democratic Society

Therefore, if we wish to change the initial conditions of the world system of thought, i.e., the moral and intellectual values governing education, we should hopefully see a change in the systemic outcomes. That is, if we believe in the idea of democracy, then we must educate our children to understand how the social world is constructed. Alongside the current emphasis on tool making, we must better reinforce our understanding of symbol making, and the manner in which these symbols are used to condition our thought and thus create the social world we all inhabit.

Ruling classes throughout the ages have always sought to exercise control over the symbol systems used to create society. Alexander, the Great, sought to do this, for example, when he wrote to Aristotle begging him not to make public the philosophical understandings he had about society. Aristotle's response was not unrelated to the symbolic use of mathematizing in current economic discourse. He replied to Alexander that the people did not understand what he was saying in any case, so there was no need to worry. Immanuel Kant apparently said the same thing to the King of Prussia regarding his own philosophical insights (Theodorides 1981, p. 113).

Education is the means currently used for embedding the ruling ideology of our historical period (Ryan 2017). This is accomplished in the schools and via the mass media. Meanwhile, because of the proclaimed value of democracy, it is now seen as necessary to educate everyone in society so that they might all participate in political decision-making. Thus, education through high school is free in most of the industrialized countries in the world, and at the university level in many, though not all. However, this education is directed to a large extent to tool making, that is, to technology and to the skills and knowledge necessary to participate in the technological society. Very little emphasis is given to the character and use of symbols in creating society. Literature, theater and art are only of secondary importance in this educational system, and students emphasizing these skills know that they are destined to second-class citizenship in later life. Not that even tool-making skills are at this moment a total guarantee of employment in the turbulent world of our currently decaying economic system. Still, hopes must be placed somewhere, and science and engineering still seem to offer the greatest employment opportunities.

What would an educational system more geared to democracy look like? Needless to say it would give equal emphasis to both tool making and symbol using skills. Anthropology and psychology would play a key role in such a system. Students would learn how societies are created and maintained through the use of symbols of all kinds: through language, art, theater and literature, clothing and hair styles, body language, the uses of education, etc. They would be taught to see the relationships between thought and behavior, between how we are taught to perceive the world and how we learn to behave in such a world. They would learn how these meanings are taught from the very first moment of life by our parents and/or their surrogates, and how these constitute our culture, with often significant differences in these basic moral and emotional meanings found throughout the world. They would learn that these meanings are couched in terms of good and evil and accompanied by deep emotional feelings, and with greater or lesser tolerance to other cultural systems, depending upon how they are taught. They would also learn that science and engineering do not replace this relativity, but become a part of it with all the symbolic means at their disposal. Their success is not just symbolic, however, as they seek to replace everything human with robots, thus making all this discussion redundant. But, then, that is what the Cultural Revolution is all about!

Students would also be taught to appreciate the importance of history as a means for understanding how thoughts, beliefs and their associated behaviors have sometimes misled people in the past, resulting in the breakdown of cultures and whole social systems. This is not a deterministic process and each experience illustrates a somewhat unique situation. What is important is the recognition that symbol systems play a crucial role in convincing people to act in certain ways, often long past the time when those behaviors are appropriate to maintain the system. Here the study of art, literature and theater can be useful in illustrating how this dialectic actually works, showing how symbols have played a critical role in supporting and/or criticizing the system existing at the time. Thus, in addition to the present emphasis on tool-making skills, reformed education would help to illustrate how this emphasis has conditioned modern social reality and has left little room for society to adjust, in order to regain a semblance of humanity.

As not all symbols are bound by the highly specialized nature of tool-making knowledge, they would allow a more holistic perception of social reality, where, as seen in the quantum and chaos worldview, everything is connected to everything else. This may also be more compatible with the female brain, as mentioned above, which is why symbolic reality is more likely to be feminine based. In other words, symbols are closely connected to the social hierarchy and to judgments about its appropriateness at any given time in history. This appropriateness has to do with the moral values of the time, as well as with the apparently timeless ability of different social systems to somehow survive within their natural constraints. Humans, in other words, are seen here as partners of nature, rather than their lord and master, which is a too common misperception that the successes of science and technology in controlling and exploiting nature have sometimes fostered.

5. Conclusion

We live in a fragmented world, held together by the forces of the ‘market’ and the demands of technology, neither of which offers much emotional or moral solace. Hence the widespread indications of social pathology: drug abuse, suicide, divorce, child abuse, pornography, etc. There is no philosophical framework to speak of, to address these problems and to bring some unity to society. Education could fill this gap, but it would require a major shift from an emphasis on tool making in the current western model to a more holistic one that would give equal emphasis to symbol making and using. Here we are talking about art and literature, about theater and the proper use of aestheticism, about a closer contact with nature, and ultimately about the reintroduction of philosophy into both academia and everyday life. Here we would stop dividing the world into them and us, and allow everyone to express their thoughts about the meaning of life in a true democratic manner. This was the spirit of life within the ancient agora, which should now be extended to all members of society and not just propertied men. This would require a major effort to educate all human beings about the complexities of modern society. It would also mean using symbols to accomplish this goal rather than using them to establish one’s place in the academic ‘food chain’, as dictated by the spirit of the ‘market’ so common in academia today.

The development of technology has extended way beyond the ability of society to adjust its institutions to maintain some semblance of democracy, the ideal that is still part of the vocabulary of modern and even postmodern human beings in today’s fragmented world. The disillusionment of today’s electorate with the often-distorted processes of representative democracy has already given rise to major social unrest. The restricted involvement of scientists in confronting this problem and their belief that it is somebody else’s problem may also have deleterious effects on science itself, as the recent marches for science illustrate. In other words, today’s social problems are everybody’s problems; our fragmented perception of life must become more holistic if our children and grandchildren are to enjoy a stable and productive future.

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Lifelong Learning, A Necessity in the Knowledge Society

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Abstract

In a knowledge based society, Lifelong Learning is an imperative necessity for the labor force. Indeed the complexity with which the present societies are evolving calls for continuous knowledge transfer facilities. LLL contributes to provide solutions or, at least, answers to new problems the society of the future will encounter. The fast increase in technological and scientific knowledge; the emergence of robotics and AI in all the domains of society replacing large parts of labor force; the higher retirement age and a larger share of elderly persons in the labor force, all necessitate a continuous actualization of the knowledge level of the labor force. Training sessions can have different forms: physical facilities in universities and higher education institutes as well as vocational schools; the application of technological instruments, inspired by MOOCs, allowing an easier participation in the training sessions. The availability of qualified 'teachers' with the ability to provide these updates may be a major difficulty in the introduction of LLL programs. Cost/benefit considerations are important, LLL has to be considered as an investment, because high knowledge profiles are a win-win situation for the individual and the entire society. In the past some authors spoke about a utopia of lifelong education, however the necessity for synchronizing technological evolution with the labor force leads to an obligation to overcome these Utopian attitudes.

1. Towards a Lifelong Learning System

Lifelong education has been addressed by international organizations for almost half a century. Initially, attention was focused on the broad concept of general knowledge and literacy with the objective of improving life quality of the citizens. UNESCO mandated two commissions to reflect on lifelong education: the first one known as the Faure[1] report, known as *Learning to be*, 1972, and the Delors[2,3] report *Learning: the treasure within*, in 1996. These innovative reports were followed by *The Hamburg Declaration*.[4] *The agenda for the future*, in 1997, established at the Fifth Conference on Adult Education on the initiative of UNESCO Institute for education (UIE).

The *Hamburg Declaration* reflected on the role of education in the face of the tension which characterized the world on the eve of the new millennium, exacerbated by globalization, such as the tension between the universal and the individual, tradition and modernity and the spiritual and the material (*Delors et al*., 1996). It also paid a great deal of attention to the role of the new technologies in education and the need for continuous training for job-related purposes. While it stressed the possibilities of these new technologies for the democratization of knowledge, it also cautioned against their potential to further aggravate social inequalities. Both reports[5] were permeated with a desire for a more just society, 'guided by the *Utopian* aim of steering the world towards greater sense of responsibility and greater solidarity'.

2. Concept, Mission & Structure of LLL

Learning is no longer limited to specific life periods and age groups, but needs to be seen as a 'continuum' (*Delors et al*.). Learning throughout life encompasses the necessity to adapt to learning requirements as a 'response to an economic demand', as well as the ability of human beings 'to retain mastery of their own destinies'. Learning throughout life needs to be guaranteed through 'flexible types of education' that provide equality of opportunity to all learners, a point which is stressed as a necessary premise of democracy.

Knowledge accumulation is increasing at a very high speed at an exponential pace. In particular the increase is made visible through the lifetime of manufactured products, which are getting much shorter than in the past, at least for some industrial sectors. Further, the interaction between humans and machines will become, according to some authors,[6,7] a new issue for the labor force and their representatives. Indeed, this new relation will be increasingly based on the use of knowledge, which means that the professional skills have to be adapted consequently.

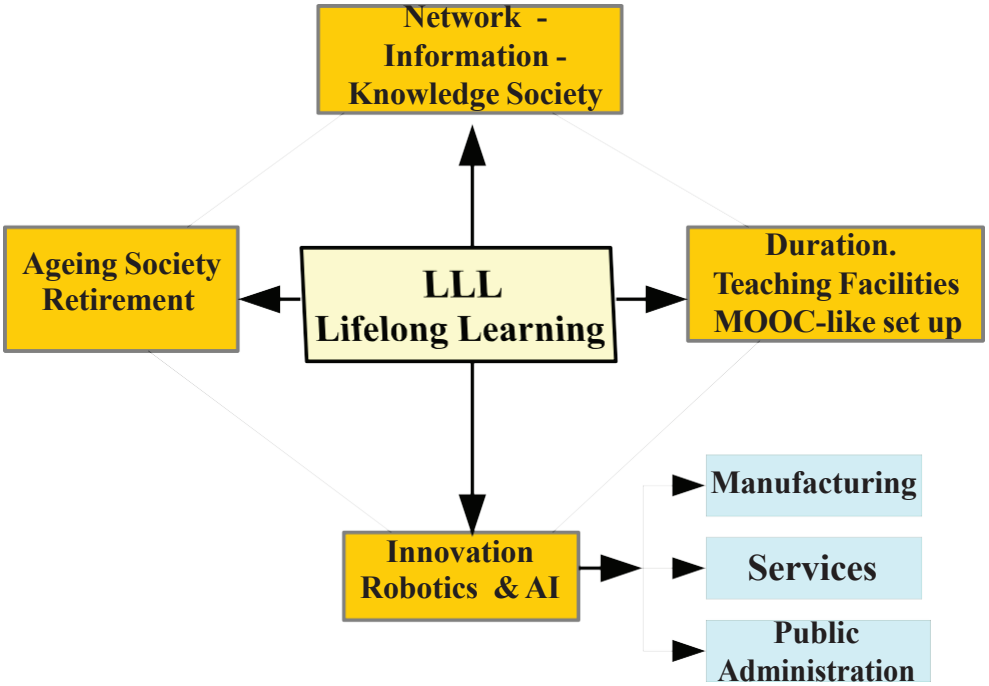
The concept of labor, on which the industrial society is based, has its origins in the 19th century with the emergence of the industrial production processes. Essentially this concept has not changed since the length of the working week has been reduced substantially in the 20th century, but the dramatic change with the emergence of Robotics and AI has not yet taken place. In fact, given the profound change of society, a new thinking about the place and the value of labor has to be formulated anew, by sociologists, philosophers and politicians as well.

Looking for answers in the profoundly changing society, a solution will appear in the *lifelong learning* structure. This concept is not new and has been proposed by several authors and institutions, however the formulation of a *structure* remains to be elaborated, which will be drafted here.

Industrial societies and the emerging knowledge societies are inherently complex structures. Almost all domains of society will have to cope with transitions to new ways of working, shorter work time per week, retirement at higher ages, a more

sophisticated relationship between humans and machines… In order to face this complexity, the labor force has to be prepared to adapt to these new situations which occur during an entire work lifetime.

Figure 1: Lifelong Learning



2.1. Duration of the Learning Process

The LLL process should be spread over the professional lifetime of individuals. As a work hypothesis, the structure could have the following composition for a lifetime:

- two or three periods of knowledge actualization;
- starting age around 45 to 50 years. This age corresponds also to the difficulty of finding another job for the unemployed. The difficulty resides in the high salary costs and the a priori negative image of aged individuals;
- length of the actualization period could have different profiles:
  - either on a weekly basis, allowing the continuity of the job of the individual in the company;
  - or periods of one to three months, eventually with one or two interruptions of work.

2.2. Training Facilities

The location for lecturing can either be within the companies, or in the usual teaching facilities.

In the first place, higher education facilities such as universities, higher professional and technical institutions can be considered as appropriate facilities for LLL. The question arises as to whether these institutions are ready today to face this challenge.

In the second place, vocational institutions need to focus on specific industrial branches. Many of the jobs will be replaced by robots, but still the knowledge and the human-machinery interaction remain to be actualized.

A major question arises as to how small enterprises cope with the training periods of their personnel. Somehow, either the market offers well trained individuals or these enterprises organize themselves into groups, allowing the participation of their personnel to specific training sessions.

2.3. MOOC[8,9] as Inspiration

The use of media technologies allowing indoor learning or the training sessions should be encouraged. The experience with MOOC (Massive Open Online Course) could be a guide for designing professional training in LLL.

A MOOC is an online course aimed at unlimited participation and open access via the web. In addition to traditional course materials many MOOCs provide interactive user forums to encourage community interactions among students, and professors. MOOCs are a recent and widely researched development in distance education, which were first introduced in 2006 and emerged as a popular mode of learning in 2012. Basically MOOCs rely on university course content and address a student audience. MOOCs show, in the short period of their existence, a large participation, however, the limited percentage of successful completion of the course is a concern.

Lifelong Learning has quite a different objective, it addresses professional individuals who need to actualize their professional skills to be used in the company they are working in, or to be better prepared to change professional careers, the latter by choice or by necessity. In a similar way, the 'teachers and professors' need to have sufficient industrial expertise and awareness of the technological evolution, in order to transmit the required knowledge to the participants. The latter seems to be a real challenge.

3. From the Network[10] to the Information[11] to the Knowledge Society[12,13,14]

Half a century ago, several new names have been proposed for the evolution of the industrial societies such as: network society, information society, knowledge society, postmodern society, postindustrial society, etc. Two important new elements have to be added: the domain of Robotics and Artificial Intelligence. There are more to be expected, and could be in line with fast developments in biological and genetic sciences.

Network society. At the end of the twentieth century, the concept of the network society gained importance. For Manuel Castells[10], network logic is besides information, pervasiveness, flexibility, and convergence a central feature of the information technology paradigm. As an historical trend, dominant functions and processes in the Information Age are increasingly organized around networks. The network society is the result of *informationalism*, a new technological paradigm.

Information society. The global information society is meaningful only if it favors the development of knowledge societies and sets the goal of "tending towards human development based on human rights". This objective is all the more vital since the Third Industrial Revolution, the revolution of new technologies, and the new phase of globalization that accompanies it, has swept away many familiar landmarks and accentuated the division between the rich and poor, and between industrialized and developing countries, as well as within national communities. For UNESCO, the construction of knowledge societies "opens the way to humanization of the process of globalization."

Knowledge society. A knowledge society differs from an information society in that the former serves to transform information into resources that allow society to take effective action, while the latter only creates and disseminates the raw data. The capacity to gather and analyze information has existed throughout human history. However, the idea of the present-day knowledge society is based on the vast increase in data creation and information dissemination that results from the innovation of information technologies.

One of the essential pillars of the knowledge society is education. It is recognized that this platform for the development of the knowledge society is an essential support for building a new social structure based on a new quality of life. Our brains are good at many things, but machines are good at other things. Bringing them together gives us the best of both, with a complementary approach letting humans and machines learn together. The Singularity University[15,16,17] is thinking in that direction and is a source of inspiration.

In the present contribution, LLL has a limited scope compared to the concept of lifelong education and is positioned among the following parameters:

1. The speed of innovation specifically in the field of microelectronics has been well illustrated through the well-known *Moore's Law*[18]. The validity of this correlation has been verified over several decades and obtained the status of the driving force of technological and social change in the late 20th and early 21st centuries;
2. The demographic evolution resulting in a longer professional work time, with the challenge for the labor force of being up to date;
3. The transition from the information society to the knowledge society is taking place right now, and appears to behave as a deterministic change.

Thus LLL has the mission to assist societies in the implementation of the technological innovations based on knowledge, for which fundamental societal modifications have to be adapted.

4. The Emergence of Robotics and Artificial Intelligence

The pervasive implementation of robotic hard- and software engines is getting close to changing society profoundly. The concept of labor has to be adapted to the novel technological environment, perhaps more now than in the late nineteenth and early twentieth century. It is estimated that the impact of Robotics and AI will affect 47% of the labor force. This will have a dramatic effect on the social structure of industrial societies. The value of work in society as well as for the individual, has to be urgently rethought and re-evaluated.

4.1. In the manufacturing industry. The machine-human[10,11] relationship will be different compared to the present state. Indeed, the knowledge relationship between the two actors, namely of the devices driven by Artificial Intelligence algorithms will change the behavior of the human operator of the machinery, for the knowledge content will be more sophisticated than ever before.

Machine learning[19]—sub-field of computer science—has evolved from the study of pattern recognition and computational learning theory in artificial intelligence. In 1959, Arthur Samuel defined machine learning as a "Field of study that gives computers the ability to learn without being explicitly programmed". Machine learning explores the study and construction of algorithms that can learn from and make predictions with data. Such algorithms operate by building a model from a sample

training set of input observations in order to make data-driven predictions or decisions expressed as outputs, rather than following static program instructions strictly.

Several speculations have been formulated in the literature about the dominance of the device to the employer, but one may state that the knowledge intensity of the employer has to match and keep pace with evolution of the technology. More in particular, data-engineering skills will be required from employees and workers previously involved in routine tasks.

In the service sector the robots are also expected to enter the workforce, which in some countries is already happening e.g. Japan and China. Indeed, in Japan, the aging of the population will require more assistance at the individual level and it is expected that robots will be an adequate replacement. In a similar way in the health sector, e.g. hospitals, robots will enter or complement professional labor force, for a lack of skilled personnel is expected.

4.2. In the private and public administration, software robots will take over massive repetitive work which was and is still being done today by civil servants. Frequently claimed simplification of administrative processes appears not to be very successful up until now, however the advent of software robots and the excessive rising costs for personnel support the introduction of robots.

5. The Demographic Frame

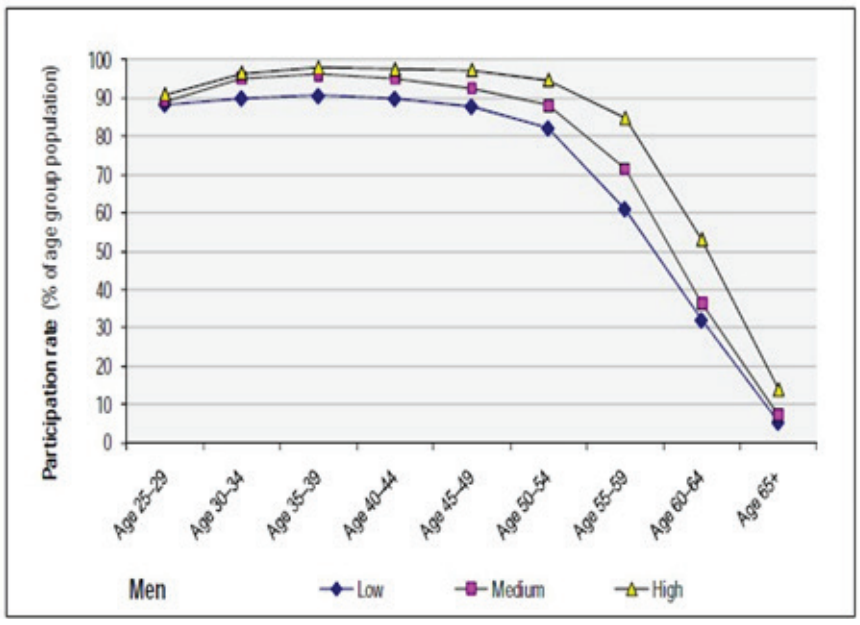
The International Labor Organization ILO[20] analyses the demographic evolution as follows: in pre-modern times, fertility and mortality rates were very high and in balance, leading to slow and constant population growth rates. With industrialization, population dynamics are passing through different stages:

- Population increases due to continuously high birth rates; a decline in mortality rates especially for children can be observed and leads to a higher share of youth in total population;
- Thereafter, declines in fertility lead to lower proportions of children and as the large youth population from phase one moves into working age, there is a higher proportion of working-age adults. This phase is temporary, lasting typically for about 40 to 50 years;
- In the next phase, fertility and mortality decline further and longevity increases. In addition, the large working-age population gets older. All this leads to increasing proportions of older persons— a phenomenon called "population ageing";
- In the final stage, low birth and death rates together with low fertility rates result in constant but very low population growth, or even declining populations.

It is interesting to note that the number of persons under 15 will stabilize over the coming decades after having increased by 30% since 1970. In comparison, the size of the working-age population (aged 15–64 years) will increase by 30%, and the population over age 65 will nearly triple to represent more than 1.5 billion persons by 2050.

On average, adults who spend more time in education or training have a higher probability of being economically active and a lower probability of being unemployed. In the EU-25, skills level is a particularly important factor in the employment of older workers.

Figure 2: Labour Force Participation Rate (%), Men, EU-25, 2006



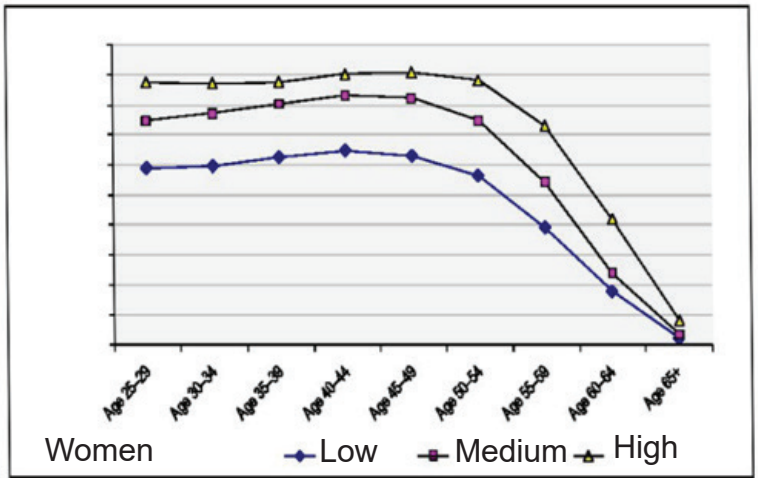
The average retirement age of the population[20] rises as a consequence of the increase in the average age of the population, given the tradition that the earnings of the labor force rises proportionally with the number of employed years. A new problem arises, older unemployed professionals have on average more difficulty to find another job, either because of the lack of knowledge or due to their ambition to earn higher wages. The lack of knowledge is becoming highly problematic. In some industrial countries enterprises do not find the needed skills on the market, even in countries with high rates of unemployment.

Figure 2. represents the participation of the male population in the workforce organized per age group with 5 years of experience, sex and skills level in EU-25, 2006[20]. First of all, with rising age of retirement, the curves will shift to the right, meaning that the population will work longer, and secondly, with investment in LLL the 'plateau' of participation will also shift to higher ages. Thus unemployment of older individuals will or could decrease.

Figure 3. represents the participation of the population in the female workforce organised per age group with 5 years of experience, sex and skills level[20]. At all ages, activity rates are significantly higher among the more educated, with the link between skills level and labor market participation being more pronounced for women than for men. The difference mounts up to 30%. This raises the question whether the participation of women in LLL will be higher than for men, or not. Anyhow the curves will shift to the right, as for men and women, for the entire society becomes older. However, it remains to be seen what the effect of Robotization will be on the average age of working.

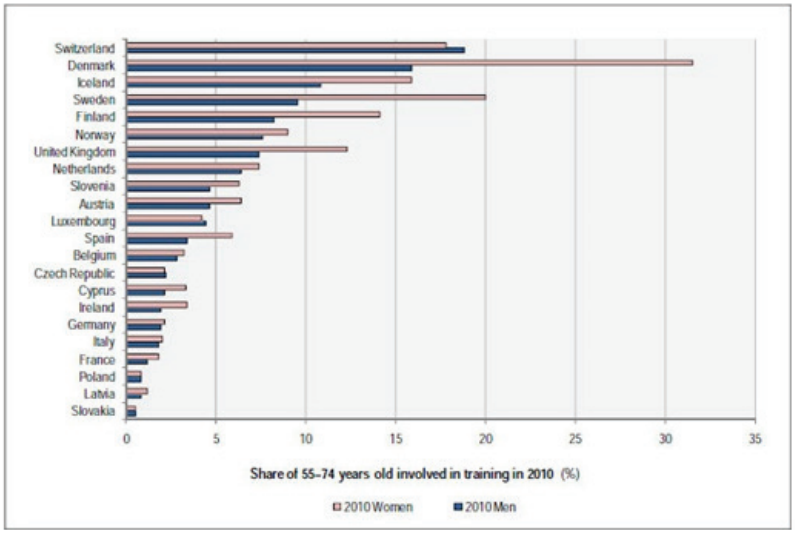
Participation of older workers in learning and training is among the highest in Scandinavian countries where the principle of "lifelong learning" makes up an integral part of national education and labor market policies. A notable feature of education in these countries is that they follow a "life course approach" relying on the constant updating of qualifications throughout an individual's entire working career. The basis for these high training rates is a well-developed social dialogue and the involvement of social partners in providing both the legal framework as well as training opportunities "on-the-job".

Figure 3: Labour Force Participation Rate (%), Women, EU-25, 2006



In contrast, in many European countries, lifelong leaning policies are still in a start-up phase. In these countries, training rates of older workers lie well below those of mid-career workers. The competitive disadvantage of older workers is clearly high, thus fostering the prevalence of stereotypes concerning their qualification profile. It is noteworthy that the figure shows much higher involvement of older women in training compared to men, in most countries.

Fig. 4. Share of 55-74 year olds involved in training in 2010 (%)[20]



The usual age of retirement has been 65 years for many decades. Today there are public debates focusing on the need to increase that limit to 67 years or more[21]. The retirement age and the year of reference for each country are listed in table 1.

Table 1. Age of Retirement in some Countries

Country	Year	Retirement Age
Denmark	2015	65
France	2015	60
Germany	2015	65y3months
Greece	2015	67
Italy	2017	66y1m-66y7m
Japan	-	60
Netherlands	2015	65y3m
Sweden	2014	61-67
Spain	2015	65y3m
UK	2017	65/64
US	2015	66

6. Cost Benefits: A Rough Estimation

Estimating the public expenditure of the future LLL system appears to be for now a difficult task. Indeed, some of the functions of LLL will/could be provided by private institutions or by the enterprises themselves.

Table 2. Education Expenditures

Country	Year	Education Exp./[22] Total Exp. Ratio%	Education Exp./[23] Total GDP Ratio%
France	2013/2012	9.66	5.9
Germany	2014/2012	11.14	5.1
Japan	2014/2012	9.29	3.6
Netherlands	2014./2012	12.0	6
UK	2014.2	13.66	5.6
US	2014	14.55	5.6

Education expenditures related to the total state expenditure and GDP are presented in table 2. Data are from references 22 & 23. It is clear from the table that the countries have different ways of financing their education system.

It is generally accepted that the spending on education has to be considered as a societal investment. The benefits are multiple and considerable, and thus as a first apprehension, the overall result would be positive. If an average increase of state expenditure for education would be estimated to be about ~1.0%, and related to GDP around ~0.5%, the major question is: are governments ready to increase the spending for knowledge training of a large part of the active population?

It should be noted that some countries e.g. Denmark[24] have introduced similar and specific programs to reduce the unemployment rate of their elderly professionals, with success. Even the notion of sabbatical periods is mentioned.

7. Conclusions

LLL is a complex matter for it involves large parts in the labor force of the manufacturing businesses, the public and private administrations. LLL has the mission to actualize the knowledge level of labor force, enabling the professional active population to be on track with knowledge accumulation.

Universities, vocational schools, as well as MOOC inspired methods will play a central role in providing training sessions for enhancing the skills of professionals.

Some major problems are: finding qualified 'teachers' who are able to transmit up-to-date knowledge; the time consuming process of LLL represents a burden for small companies. Estimating the cost/benefits ratio of LLL is, for now, too difficult. However, it is clear that the higher the knowledge level of the labor force, the better the society manages its integration in the knowledge driven society.

The initial reports on lifelong *education* expressed their possible utopian character; in an analogous way, lifelong *learning* as analyzed here could also be labeled as 'Utopian'. The future will appreciate in which degree the complexity of the endeavor can be materialized.

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Higher Education and Small Countries

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Abstract

*The world at large is essentially a world of small states, and in Europe, nearly two-thirds of the countries could be classified as 'small'. Science, technology, education and innovation (STEI) are crucial drivers for an increase in national wealth and economic development; small countries are no exclusion. Education today is increasingly focusing on what is needed knowledge for a certain time, rather than being seen as the process to accumulate knowledge. The main purpose of education these days is to provide students with certain specialist knowledge needed for a job, and the most important is to prepare them for future learning. To provide students with enough knowledge and experience for a job means a good relationship among academic staff and institutions with surrounding industry so as to contextualize the curriculum for real life. To prepare students for "lifelong learning" is more complicated. This process is more complex in small countries because of their not having developed infrastructure, or the human and economic potential to follow the trends of development. Furthermore, in the field of research and education, new technologies have increased the challenges faced by small countries. This basically means creating a balance between theoretical and practical work. In the world which is characterized by an "**unknown future**" the following premises should be common: our students need to be very adaptable, flexible, creative, lifelong learners and tremendously curious. Thus, in order to provide future generations with the proper skills and knowledge it is most important not only to know how higher education institutes would accommodate to new challenges but how the process of education will be transformed.*

1. Introduction

In providing global public goods, science, technology, education and innovation (STEI) serve as crucial drivers for raising prosperity and improving national competitiveness. Innovation and technology are needed to transform countries' shift from reliance on the exploitation of natural resources to technological innovation as the basis for development, which is, in particular, required for small countries.

Every nation manages education in its own way, but in that process there are some countries that are far more efficient than the others. Education is not restricted to large countries. Some of the top 20 education systems in the world are actually in very small countries. Education is increasingly seen as a major contributor to national wealth and economic development.

Education is increasingly becoming "just in time" rather than "just in case". It is more about what is needed to know for a certain time, than accumulating knowledge that may never be needed. Universities, while educating future generations, emphasize their role as being the basis for innovations. In order to provide future generations with the proper skills and knowledge it is most important to realize how higher education institutes would be affected by the Fourth Industrial Revolution and how the process of education will be transformed.

2. Education and Time

The small country is a relative concept, it might be reasonable to consider it a small state if it has less than 10 million people. Under such a definition the world is a world of small states in which many of them have populations of less than 5 million, and about fifty have populations below 1.5 million. In Europe, nearly two-thirds of the countries could be classified as 'small' countries.

The basic purpose of higher education is in many folds.* The main purpose should be to provide students with certain knowledge needed for a job, and the most important is to prepare them for future learning. This basically means creating a balance between theoretical and practical work. To provide students with enough knowledge and experience for the job should be an easier problem to face. It needs, above all, a good relationship among academic staff and institutions with surrounding industry so as to accommodate curriculum in real life. To prepare students for "lifelong learning" is more complicated. Basically, at present, it looks like this problem is solved, at universities in many countries, mainly with additional courses such as M.Sc., Ph.D. or specific diploma. Students should understand that education by itself would not fully prepare them for a job, since skills they would need to be successful will continuously change. Therefore, the ability to learn for life is essential. This process is more complex in small countries because of their not having developed infrastructure, and human and economic potentials to follow the trends of development.

Universities are a unique kind of global institution, institution intended to be durable and enduring. When properly established, governed and financed, universities are special institutions. Universities should foster development through direct engagement so as

* The benefits of higher education are not only career oriented but also include in the 21st century the following factors:

- Economic
- Civic Involvement
- Personal Development
- Better Communication (verbal and written)
- Realization of aspirations
- Health
- Greater Sense of Discipline
- Sense of Accomplishment

to adapt and innovate, embrace their cultural, socioeconomic and physical settings, while at the same time being socially embedded. Universities should become successful by becoming student-centric, rather than faculty-centric. They have been for long vital and powerful drivers of global innovation and economic development. Today, universities must break free from outmoded paradigms if they plan to achieve meaningful progress.

The world outside schools is changing at a tremendous speed. Jobs for life are almost non-existent, and look like utopia. Most of the students today experience a "mash-up" of micro jobs. They will face jobs that we cannot even imagine today. They will live with technologies that most of us have never even dreamed about. It looks realistic that, in their life, today's students have to be prepared to change 10 to 12 different careers, having multiple jobs at the same time. Regarding such prognoses schools are still using the same methods, the same processes to educate future generation. Thus, starting to educate for the 4th Industrial Revolution seems to be coming a bit delayed. It is in the elementary and high schools where young people should start to build learning skills necessary to master the 4th Industrial Revolution.

Smaller countries have a special role to play in the international higher education system. How does size matter when it comes to educational success of small countries? Among the problems common to small countries for education, three deserve specific attention: economic vulnerability, isolation and high costs of administration. Equally they share a number of disadvantages in comparison with their larger neighbors, such as limited human resources, limited funding, difficulties in setting priorities and a small base for direct innovation and diverse curriculum. Beyond having those disadvantage small countries have advantages: they can accommodate faster, develop and introduce innovative changes faster, which equally applies to education. On the other hand, opportunities in small countries for 'open innovation' partnerships between multinational companies, SMEs and universities and the tertiary sectors look less challenging. Globalization certainly asks new questions about the relations between population size and development.

The profile of educational development is in most cases modeled on what is appropriate and fashionable in large states. Educational planning in small countries is often a bigger challenge than in large countries. Small nations should not be treated as merely scaled-down versions of larger countries. Obviously, there should be many factors which influence particular strategies in the smaller states. These include remoteness and isolation of small communities, no economies of scale, greater transparency, closely knit social organizations, critical shortage of essential manpower and heavy dependence on external assistance. Beyond many other issues when planning education in small countries there should be found balances between the demands of "small-state nationalism" and the realities of economics and international dependence.

Internationalization of teaching and research are critical objectives for most small countries. Many small nations, including prosperous ones, introduce limits in the process of education which they can provide for their citizens. To improve this, smaller countries have to do much more in international society to gain visibility and awareness of the quality of their education system. On top of all this, they should try to attract the brightest minds to their education systems. Many degree programs often depend on international students. The special problem arises in the process of attracting the best students and staff when it comes to raising quality standards and global relevance. This has resulted in fewer universities in small countries and fewer choices for prospective students.

The smallest countries can hardly operate universities; and those that do can only practice a restricted range of specialties. The solutions to these limits vary. One is to send their students abroad.* The key feature of the global tertiary education sector has been the growth in number of international students. TNE (Transnational education) is attractive to students looking for a foreign diploma without moving from their country of residence. When considering future opportunities for TNE, whether through joint or independent initiatives, a number of key drivers involved should be considered. Another possibility is to establish regional universities. This solution experiences, often, severe political misunderstandings since "national pride" often requires at least some domestic higher education provision. In that line, in some small countries, there are universities which, usually, cannot compete with the needed standards. External institutions are often perceived to be less relevant to local needs. All these solutions have merits and problems. Thus it looks like there is more economic sense in sending students abroad, and/or making arrangements with external institutions (TNE), than trying to do everything domestically.

There are a variety of ways in which education is performed transnationally: via distance education, twinning programs, articulation programs, branch campuses, and franchising arrangements. Such a model of education is attractive to employers and governments looking at options for human resource development. In this process multinational or global corporations with a geographically dispersed workforce should be included. This sort of education has been related closely to world trade growth as well as world GDP growth over the past 20 years.

The demographic and economic movements, at a global level, will affect the tertiary education sector—it is expected to grow more than one per cent/year on average, compared with five per cent/year in previous decades. It is expected that the growth of student mobility (international) will follow these trends, which will lead to a significant reduction in student mobility.

The contemporary system of the neo-liberal ideology has increased the economy of higher education systems around the world. Promoting competition, efficiency and revenue generation, many countries have recruited larger number of foreign students. In that sense higher education has become a profitable activity to be traded internationally. (In USA it is a top business economy.) Nowadays,

* The number of international students in tertiary education rose from 800,000 in the mid-1970s to over 3.5 million in 2009. Total global tertiary enrolments are forecast to grow by 21 million between 2011 and 2020, or 1.4 per cent per year on average. This compares with the global tertiary enrolment growth of five per cent per year in the previous two decades (and almost six per cent between 2002 and 2009), which indicates a significant slowing down in growth rates of tertiary enrolments to 2020.

some small countries (Ireland, Finland), where successful learning and innovation systems were created, play a significant role in the international student market. Furthermore, Eastern European countries have transformed their higher education systems into some of the fastest developing systems in Europe. They are active in opening new degree programs, even in small countries, and equally in student mobility. Furthermore, there are some very small European countries with populations of less than one million people, which have been very active in the higher education field.

The central critique of contemporary university education is that lecture-based instruction, which is today the most common mode at universities, does not effectively engage students' interest or help students develop the conceptual understanding and 'liquid' skills they would need to address tomorrow's needs. Thus, education today is failing to prepare young people for their working future. Young people need to develop right-brain skills (creativity) just as much as left-brain skills (mathematics and technical) to adapt to the emerging economy. Certainly, the most needed 21st century skills will be: creativity, critical thinking, collaborative ability, adaptability, communication skills, citizenship, and character skills. In that sense digital tools need to be used so as to let young people learn anything they need to achieve success.

3. Small Universities and Research

It is not easy for smaller countries to find answers to questions such as 'why conduct research?', 'how much research can a country afford?' and 'to what extent should research be controlled?' The United Nations Task Force on Science, Technology and Innovation noted that innovation and technology are needed to transform countries from emphasis on reliance on the exploitation of natural resources to technological innovation as the basis for development, which is the most important issue in small countries. Innovations are important to every sector of the economy. The learning opportunities for innovation come from investments in new machinery and equipment, technology suppliers, mobility of labor, interactions with other knowledge agents, trade and investments, and certainly from research. Knowledge accumulation in any country depends on steady investments to increase science education improving the STI policy. In that way it is possible to foster innovations by learning and research. This can be achieved by incorporating science education in the curricula from primary and high school levels to the encouragement of research poles around existing universities. The partnership of university research institutes with industry, broadening the culture of science, technology and innovation, and making science and technology accessible to all levels of learning, are key issues.

Collaboration in academic research depends on a number of factors. It does not simply represent growth in the overall higher education system-ring. It has been estimated that informal networking between academics is mostly responsible for initiating joint research projects. It has been found that 80 per cent of countries' research impact is explained through their collaboration rate, i.e. the higher the international research collaboration rate, the higher the impact of the research output.* Internationalization of research is a crucial issue for most tertiary institutions, and in particular for small countries. For example, the foreign scientists from developing countries who are involved in international research produce 4.5 times more publications and 10 times more patents than their colleges at home. It has been recorded that internationalization of higher education tends to move to a new stage, i.e. the international students will continue to play an important role, but research and joint delivery of education will be growing with overseas partners. Maintaining international relevance through teaching and research should be a key preoccupation for the tertiary sector in most small countries.

In many ways, in the field of research and education, new technologies have increased the challenges which are faced by small countries. For example, the Internet has reduced, by providing electronical access to a variety of information, the problems arising due to the lack of libraries in small states. Furthermore, the Internet also facilitates distance learning. It provides to personnel in small nations specialist assistance so they don't have to go abroad. In that way small nations are becoming more fully integrated into a globalized world. These factors have major implications in curricula, examination systems, and even research.

Higher education and the need for research are among the principal reasons for permanent migration. The international student mobility is driven by demographic and economic drivers. The international student movement, which has been very much driven by student recruitment, nearly equally for education and research in the past decades, was largely towards the advanced countries. It has been enlarged since the second part of XX century. Certainly, there are other key drivers, such as the legal framework in overseas markets governing transnational education, as well as, in particular, better possibilities for research. The outbound mobility ratio (mobile tertiary students divided by total tertiary enrolments) has remained stable from the early 1990s at the rate of just over two per cent.

Higher education has played an important role in promoting sustainable development during the period that has just ended. It is especially important to continue to do so regarding the post-2014 implementation of the GAP†, the document on education for sustainable development.

* China and the USA contributed to the largest growth in collaborative articles with the US producing 78000+ articles since 2000 and China, 40000+ articles; growth to 2020 is expected to be driven by high volume markets, with China matching the US by the end of the decade

† GAP (Global Action Programme) is generic in nature and applies to all levels of education. It identifies five priority action areas:

- mainstreaming education for sustainable development in both education and sustainable development policies;
- transforming learning and training institutions by integrating sustainable development principles in daily activities;
- building capacities in educators and trainers;
- empowering and mobilizing youth; and
- accelerating the implementation of sustainable solutions at local and community levels.

4. Conclusions

Mainly due to advanced and emerging economies, the last decade was the time of many changes in the higher education sector, so it is expected that the coming time is going to experience even larger changes in higher education. These changes will happen not only because of advancement of technology. They will be characterized by intensifying competition and strengthening collaborations globally. This is, in particular, very important for higher education in small countries. Following shifts in economic power the tertiary education sector will move more to the east and less to the south.

Many of tomorrow's professional fields are not known today, and are even hard to predict. In such a situation, in small countries, a fundamental solution for the higher education sector would be to address it in such a way that the students would be competent to self-educate during their career. In that way they would have the capacity to compete, not only in the field in which they obtained undergraduate education, but in new professional fields. Certainly, this issue questions the basic pattern of higher education*, in particular undergraduate study, as practised in many countries. The question is, what should be the concept and what should be practised in basic higher education (first 3/4 years) and in the second stage (one, two or more additional years), and for what purpose? In solving this problem it should not be forgotten that, especially in small countries, informal education is going to play a significant role. Another very important issue should be: how is research included in this process? Basic research is the key driver of innovation; the academia-industry connections should play the major role since industry helps researchers to implement their ideas to market products. In particular basic research should take place at universities in small countries but that is not a common case today. Basically, the relationship between teaching and research has to be reexamined. In any solution, developing and encouraging creativity and innovation should be the focal point**.**

Altering higher education looks more necessary than ever before! However, higher education institutions need to act to ensure effective and immediate transformation. Certainly, "digital higher" education can be more affordable and efficient compared to other education options. In any case one should consider the best ways to reach all populations, since education should play a crucial role in changing contemporary practice.

In the world in which we live today which is characterized by "*unknown future*", the following premises should be common: our students need to be adaptable, flexible, creative, lifelong learners and tremendously curious. So, there is the obligation to create the models and contexts of higher education so as to make "it happen", otherwise we will have generations with shortage of skills to meet the new demands of the labor market. There would not be, in future, shortage of jobs, but there would be shortage of skills, which will become a big problem to society. In any case, ubiquity of change must be on top of our minds in the consideration of any educational strategy.

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* B.Sc + further degrees: basic 3-4 years courses + further higher education in M.Sc., Diploma or Ph.D. courses.

Teaching Assistants (TAs) as Secondary Facilitators in an Academic Support Unit in a South African University

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Abstract

Student learning and development is the central purpose of higher education. It is common practice that higher education institutions, globally, adopt teaching and learning systems that focus primarily on staff and student development. Teaching assistantships are common funding sources for postgraduate students which at the same time assist departments in meeting their needs and achieve flexibility necessary to accommodate and respond to course and module challenges. This practice aims at creating an enabling, effective and supportive learning environment which meaningfully contributes to the overall quality of learning, successful throughput and student retention. A variety of duties is performed by these individuals; amongst others, they lead laboratory and teaching sessions, help with marking and entering of marks, carry out administrative duties, mentor others and so on. Noticeably, most teaching assistants receive little training before taking on their duties whilst at the same time have enormous responsibilities. It is contended that they are literally thrown into teaching environments in a sink or swim manner with no experience or training. This paper seeks to investigate the nature of the TAs' experiences as secondary facilitators in an academic support unit under the guidance of academic literacy lecturers. Semi structured interviews were used as methods to collect data. Underpinned by the constructivist approach whereby the TAs construct their conceptual and content knowledge understanding through guidance and training from experienced lecturers and faculty members of staff. This approach was used to frame and analyse this work. Findings reveal that teaching assistants need to be trained continuously on the job and that such programmes develop aspiring and future academicians, unintentionally, as most of them developed a great passion for teaching and thereby expressed a wish to switch their professions.

1. Introduction and Background

Specific duties of teaching assistants vary by course, discipline, and institution. As for lecturers who are their primary mentors and guiding counsellors, operational activities at departmental level are essentially driven by the teaching and learning philosophy of an institution which is a reflective and systematic statement that defines an individual's or an institution's conception of effective teaching and learning, taking into account the institutional and social contexts in which teaching and learning may occur. There has been limited research in terms of the experiences of teaching assistants in the higher education sector in South Africa. The focal study in this paper is the University of Technology, Durban in the KwaZulu-Natal province. Student engagement in the unit customizes or tailor makes its teaching methods and approaches in order to accommodate diverse fields of specialization focusing on their unique discourses, e.g. technical vocabulary for engineers. One of the guiding principles of the teaching and learning policy of the institution is to provide the full range of social and academic support to ensure that its registered students are enabled and empowered to make the transition from school to university. To what extent therefore do teaching assistants contribute to the success and throughput rates of students in the area of academic support during their tenure as senior students at the university? In this context, assisting with the monitoring and supervision of students' work from a variety of disciplines in the faculties of engineering, natural sciences and management sciences is one of the primary functions of the teaching assistants. The university also provides a high quality, technologically advanced service to students in order to improve throughput rates through its integration of eLearning platforms.

2. What is a Teaching Assistant? (TA)

Teaching assistants fall under the category of peer facilitators, like, student mentors, writing consultants, SI leaders, student assistants, etc. In this context, the experiences of teaching assistants in an academic literacy unit will be explored. In general terms, literacy involves far more than the ability to read and write. Although one already has conscious command of the basic skills of reading, writing and speaking, there are many other aspects of literacy which one has been unconsciously using. School subjects, for example, each have their own style of literacy (known as a discourse) which includes a specialised vocabulary and a specialised way of reading, talking and writing about texts. In this sense, literacy in Science is different from literacy in English. In its broadest sense, literacy involves using language for thinking and meaning. It is helpful to understand literacy as having three different aspects (Green: 1996), namely, operational, cultural and critical literacy. Teaching assistants are literally thrown into teaching environments in a sink or swim manner with no experience or training. In this context, in order to meet the needs and expectations of all students who come to the unit for English remedial intervention purposes, it is always of great assistance to acquire the services of teaching assistants or tutors to provide an academic literacy and complete language service to students. They also have additional duties of assisting in the reading and language laboratories. This gives them the opportunity to engage in the unit to assist them in enhancing their teaching and learning skills, strategies and technique. However, the researcher wishes to investigate if they are thrown in the deep end of managing the classroom behaviour and carrying out duties and responsibilities they were never trained or coached for. The significance of this study focuses on their experiences in this regard. Student mentors, amongst other things, display exceptional, high achieving or self-driven capabilities with a good command of English. They need to be well trained in order to assist "at risk" students and other peer assisted learning as mentioned above. It is also important to consider how institutions can better prepare TAs for their teaching responsibilities, to maximize their success both in the classroom and in their future careers and to increase their confidence and skills in dealing with challenges as they arise (Amlung, L. et.al:2015).

3. Literature review

Teaching assistants' roles have changed dramatically from being the historical classroom assistants to developing professionals and future academicians (Visser et. al, 2017; Amlung et.al, 2015; Cassidy, et.al, 2014). Cultivation of TAs' learning and understanding also depend on learning from each other in communities of practice. To draw on work done by researchers in academic literacy, McKenna (2004), Van Dyk, et. al. (2013), Evans and Morrison (2011) contend that academic literacy comprises the norms and values of higher education as manifested in discipline-specific practices. Students are expected to take on these practices, and the underlying epistemologies, without any overt instruction in, or critique of, these ways of being. Further, the development of the academic literacies is an essential graduate attribute for all students (Paxton and Frith: 2006). It is therefore argued that university lecturers should not expect or look for error-free and finished products from students but rather be part of the preparation and guidance of students in the reading and writing process. Embedding academic literacies in discipline-specific curricula is crucial rather than teaching academic literacy as generic skills courses is essential. It is for this reason that developing teaching assistants in reading and writing development practices becomes an integral part of student development in a variety of genres in higher education. Academic writing, per se, supersedes all required and acquired soft skills as assessment and evaluation ultimately take place through tests and examinations in standardized forms characteristic of universities. Academic literacy is knowing how to act in terms of reading and writing in a particular discourse (van Schalkwyk: 2008).

Attempts have been made to strengthen the capacity of teaching assistants in the academic support unit in the direction of developmental workshops. Engaging the teaching assistants, on a continuous basis, with academic writing skills development, it is hoped that they will in future assist the students improve their written academic tasks in different genres. It is therefore important for staff to consider how they can better prepare TAs for their teaching responsibilities, to maximize their success both in the classroom and in their future careers, and to increase their confidence and skills in dealing with challenges as they arise.

4. Theoretical Framework

Underpinned by the constructivist approach, the TAs construct their conceptual and content knowledge understanding through guidance and training from experienced lecturers and faculty members of staff, and this approach was used to frame and analyse the work.

Constructivism and connectivism construct meaning whereby students in the constructivist classroom ideally become "expert learners"(Bruner: 1990). This gives them ever-broadening tools to keep learning. The key research question "What are the experiences of teaching assistants in an academic support environment in a UoT?" focuses on the novice professionals as they prepare, engage and reflect on their practices and at the same time build their future careers in a non-threatening environment where they support unprepared students in academic literacy skills development.

Further, constructivism is basically a theory based on observation and scientific study about how people learn. It says that people construct their own understanding and knowledge of the world, through experience and reflecting on those experiences. When we encounter something new, we have to reconcile it with our previous ideas and experience, maybe changing what we believe, or maybe discarding the new information as irrelevant. In any case, we are active creators of our own knowledge (Amlung, et.al: 2015). People must ask questions, explore, and assess what they know. As explained previously, the participants in this study have diverse experiences of undergraduate study and what the university experience is, overall. It is critical to examine how TAs learn to teach, demonstrate learning and adapt to teaching and learning frameworks of academic literacy and other disciplines and how they develop as future academicians.

5. Enhancing TAs' potential through Teaching, Training and Development

Teaching assistants play a pivotal supporting role in academia and it is imperative for the faculty members to develop promising and excelling students to become the next generation of teaching faculty. Many feel unprepared for their teaching responsibilities and report a lack of structured teacher training. Therefore, what kind of measures could be put in place in order to address the seemingly pervasive lack of preparation? It is a fact that TAs need to be given the basic skills necessary to begin their teaching responsibilities. Boyer (1990) contends that faculty at institutions that value research more than teaching may be ineffective teaching mentors for graduate TAs. The value that is placed on mission statements of universities cannot be overlooked whilst developing teaching assistants. Most graduate students will likely receive at least some teacher training from faculty mentors who base the value of the scholarship of teaching and learning. Scope for teaching assistants is wide as creating the next generation of faculty members is one of the main programmes that some universities have adopted.

6. Methodology

The data collection method was through semi-structured interviews whereby the researcher had initially planned to engage six participants. Purposive sampling was used as the author targeted a total of six; divided as follows: three present and three past TAs to form part of the study. According to Cohen, et. al. (2007:114) purposive sampling is a feature of qualitative research whereby researchers handpick the cases to be included in the sample on the basis of their judgement of their typicality or possession of the particular characteristics being sought. The sample is chosen for a specific purpose and as indicated, participants will be drawn from present and past teaching assistants. All potential interviewees were consulted, but only five participants were finally interviewed. This was due to work commitments from the previous teaching assistant as she could not be reached. An apology was received in

good time. Pseudonyms were used to protect the identity of the participants. What is common about the biographical details of the participants is that they are postgraduate students who annually are recruited in departments representing different faculties. Criteria used on section of candidates involve committed, hardworking and in some instances academically excelling students. It must be mentioned that the past three TAs are now based in different portfolios as employees; two are in lecturing positions and one is in an administrative position. The rationale for selecting the previous teaching assistants was to evaluate the unit practices to better inform planning and operating procedures with the end goal of transforming teaching and learning spaces for students.

The interview responses of participants were measured on a five-point Likert scale:
(where 1 = never/ disagree/not satisfied and 5 = always/ agree/ fully satisfied)

	Interviewee 1 Neezi (postgrad student)	Interviewee 2 Psypho (postgrad student)	Interviewee 3 Benz (presently: lecturer)	Interviewee 4 Koo (in admin position)	Interviewee 5 Taboo (enrolled for PgDE)
Understand my Role as secondary facilitator	4	4	4	5	5
Handling small or large groups	3	3	3	4	4
Administrative duties	4	4	4	4	4
Training or orientation received	2	2	2	2	2
Highlights and achievements	4	4	4	4	4
Setbacks (any)	4	4	5	5	5
Career pathing	4	4	4	4	5
Relations with staff	4	4	4	5	5
Relations with students	3	3	4	4	5
Further training	3	3	3	3	3
Opinions about Academic Literacy	4	4	4	4	4

7. Key Research Question

What are the experiences of teaching assistants in an academic support environment in a UoT? As illustrated above, eleven key points framed the themes of the study.

8. Data Analysis and Discussion of Findings

In her interview, Neezi explains why the training process is important and could be improved: *The Academic Literacy and Language Unit staff outlined the work I should do and gave me some orientation in terms of administrative duties. One of the experienced TAs took me along as he had been on the ground the past year. Formal training was given in laboratories by lab assistants and service providers on how to operate the Tell Me More (TMM) language learning software.*

This meant that they learnt from each other on how to handle and manage classes; formal training sessions are not in place prior to taking their responsibilities.

In most interviews, workshops by staff in writing development exposed the TAs in the writing process related to student development.

In his interview, Psypho states: *"Academic literacy should be compulsory for all students who register at MUT".* Skills acquired at the unit are termed 'soft skills'. They are very critical skills needed in the work place and the world. They include presentation skills, reading and writing skills, report writing skills, etc.

Continuous and further training was recommended by most interviewees whilst self-development was also a priority. Unit staff were also commended for playing a significant role in their academic life in the area of criticality in academic literacy.

9. Conclusion

It was noted that for most TAs, exposure to academic literacy and academic support happens for the first time, that is, once they join the unit. An important observation was also made that some of the participants did not know or did not take the opportunity of visiting the unit whilst in their undergraduate study. Lecturers and laboratory assistants in the reading and language laboratories

train, guide and mentor teaching assistants during planned sessions, on the job. What is lacking is that TAs are not prepared before taking the opportunity to serve, however, it is assumed that they have graduated and are now "competent" to serve faculty. As mentioned above, two of the past teaching assistants are presently in lecturing positions and rightfully have become academics in different disciplines of study. Training or orientation received was minimal for some of the participants and needs to be improved in the future. What the teaching assistants espouse in this particular context endorse what the institutions has set for itself in terms of the ideal graduate it seeks to produce regarding graduate attributes. To name a few, graduates must be employable and entrepreneurial, have sound disciplinary knowledge, are curious intellectually and see learning as a lifelong process.

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SECTION 8

THE RESULT: PEACE, BETTER GOVERNANCE AND NEW ECONOMICS

Education, Democracy and Peace

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We live in an Era of globalization, fuelled by rapid innovation and liberalization of habits. Our system of global governance is, however, rather primitive as much as education is, while nationalism is rising leading to civil strife and conflicts. Our ethical standards are also far from perfect. There exists inequities between individuals as much as in nations, and our environment is being destroyed.

It is important to improve the links between school education, civil society and the family, making good use of results achieved in school or out-of-school , to learning how to develop ski11s with a strong ethical component in a world of expanding information, a condition for survival and of personal and social progress to guarantee the access to societal relations and an acceptable degree of peace by means of culture, by respecting values like tolerance, understanding, acceptance of differences, cooperation and peaceful settlement of conflicts.

Improving conditions and strategies to foster the development of education is the basis for encouraging solidarity, improving the quality of teaching, and rendering the educational system more effective and useful to society. It is, in fact, important and urgent to mobilize public opinion with a view of giving greater priority to educational progress.

Within the modern context of decentralized education systems, the State will be required to strengthen its own role and to take responsibility for ensuring that the basic needs of everyone are met, equal opportunities exist and the administration has the ability to propose and manage educational changes and to preserve the impartiality of the system.

It is, however, recognized that *Democracy, Peace and Education* have become very crucial factors in the evolving patterns of modern societies as there cannot be Progress without Peace, no Peace without development, and neither Peace nor Development without an appropriate platform of Education. The dynamic interaction of these factors provides the context in which citizens live.

Education systems must be designed and monitored in order to respond to new conditions in such a way as to ensure that Democracy, Peace and Education are fostered by giving priority to underprivileged groups, and to women.

A prominent problem currently faced by higher education is the poor quality of syllabuses and of teachers, institutions, scientific, cultural and technological structures. The capacity to fulfill these needs demands cooperative work to ensure justice for deprived groups, minorities and especially girls and women abused by intolerance, violence at domestic and social level, and xenophobia. These problems have actually created an urgent need for cooperation in the fields of education, to encourage efforts and reinforce understanding for respecting individual, social and cultural differences.

The role of associations, public institutions, non-governmental organizations and the State shall not be reduced but shall grant conditions to overcome disequilibria, abuse, organized violence and environmental degradation. This new role of institutions is expected to diminish tensions and foster stronger participation of citizens, in order to build a solidary society.

The organization and role of families have regretfully changed in recent years. Families have become smaller and the number of one-parent homes (many headed by single mothers) has significantly increased. The traditional parents' role and domestic tasks have also changed, determining new types and new channels of communication. As a result, there is less control over children and youth, who now have more free time to spend in the streets and be members of groupings characterized by ignorance with lack of interest concerning history or future scenarios.

There is also a variety of profit-making institutions using low-cost teaching strategies, lacking adequate information needed to help students and their families in selecting higher education and careers.

Training elites is a crucial aspect of educational policies as the massive expansion of higher education in recent years has triggered a growing variety of institutions and generated wide differences in the quality of teaching. In fact, the goals of the concerned institutions are no longer homogeneous as the system is becoming increasingly bureaucratic, while the enrollment of students poses greater financial problems, resulting in a sharp decline in educational quality and admissions.

The role of educational institutions should adapt to actual changes generated by decentralization, new market forces and increased accountability. A balanced distribution of functions between central, regional and school authorities should be defined as they require qualified staff especially in the areas of management, informatics, testing and research. It may be necessary, accordingly, to change the criteria and mechanisms for staff selection, to collect and diffuse information for making education more transparent. At the same time, Principals and teachers should not be responsible for selecting textbooks. In summary, the design of educational strategies shall be regarded as a new challenge for implementing effective learning systems, with social consensus.

A well informed public opinion is crucial for building consensus and promote education by supporting efforts aiming at:a) improving the pedagogical qualities of teachers, b) evaluating achievements reached in any rank of educational contexts, c)

encouraging research projects and comparing the results in a systematic manner granting social approval, d) and inducing less bureaucratic regulations generated by vested interests.

Today there is a real need to improve the diffusion and sharing of knowledge and value tolerance that can reduce risk of future conflicts. One cannot in fact expect to contribute appropriately to social, economic and cultural progress if educational system produces a higher level of illiteracy and dropouts who do not possess the necessary skills to be employed.

A transdisciplinary area which we ought to examine within all these key-fields is *Education for a Culture of Peace*. This issue deals with how to educate people to respect Human Rights. This also implies decisional experience in the light of examples provided by History all over the World.

Other organizations contributing to sustain and diffuse *Education for Peace* are UNICEF, UNFPR, the World Bank and IDB in cooperation with the United Nations Development Program and UNESCO. In the United Nations the theme of *Education for Peace* remains however a principal preoccupation. The military and diplomatic apparatus deployed areas around the world are a risk for millions of people. Only Education for Peace can stop this.

It is evident that international organizations such as the U.N., the European Union, and others have an important role to play in promoting continuity and knowledge of national and international educational policies, thereby providing guidance to avoid frequent changes of governments and international organizations, and fighting corruption at institutional and political level.

A positive concept of Peace goes beyond the mere absence of war and encompasses issues based on physical violence in the sense that Peace results in Security, Security results in Peace, and Peace results in Progress eventually with the aid of Diplomacy.

Through the experience we have acquired in recent years Humanity's culture of Peace seems to grow, violence is eventually avoided through negotiations, compromises and other diplomatic initiatives, in a way that has had an effect on the human sensitivity. We have seen how the League of Nations evolved into the creation of the United Nations, though today the 'Veto power of certain Nations' at the Security Council becomes a disturbing obstruction, hampering Peace and Human Rights.

The U.N. is in fact today a very important institution for human Peace and Progress which Mankind cherishes, starting from the almost total abolition of death-penalty, slavery, epidemics and analphabetism, as the EURO-CHINA Association has heralded since its creation.

EURO-CHINA is a Europe-based organization. It was set up under the auspices of the European Union and the United Nations, registered in France. The creation of EURO-CHINA received full support by the business communities and the governmental agencies in Europe, in China and generally in all developing countries, as well as by the European Commission, the UN, the World Bank, etc. This Program fosters Peace between Nations and aims at converting centuries of errors into a heritage for future generations along the slogan: "Never more war, but Peace and Security for All."

EURO-CHINA provides assistance to nations in all these areas by diffusion of information about trade and investment, organization of study tours, fairs and exhibitions, market surveys, projects design and implementation, such as the very recent "New Silk Road" project launched by China's President Xi Jinping.

To this purpose EURO-CHINA is actually preparing a calendar concerning the next Annual Forum "Meet your Partner", with the support of institutions and enterprises from various parts of the world. (For further information please contact euro-china@libello.com)

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Education: An Essential Tool for Reaching the UN SDGs by 2030

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The last few decades we have experienced tremendous changes, as we rapidly move from a traditional capitalistic economy to a new economy. The new economy is driven by very rapid and drastic technological changes, thanks to a growing and unlimited resource—data. Information, knowledge is added to the traditional resources: land, capital and labor. Computers, communication and internet of things enable u s to drastically cut marginal costs of production in many areas. The concept of mass production and mass merchandizing is replaced by the ability of manufacturing small lots at low costs. We are not just living in an era of changes but rather in a change of era. Global economic growth in recent decades has been accompanied by the creation of immense environmental and societal risks that literally threaten the survival of humankind on planet Earth. Among the major environmental threats we should mention the depletion of major resources, the tremendous growth of air, water and land pollution, the rapid disappearance of plants and animals, the fast loss of resilience due to loss of biodiversity, the drastic—and faster than expected—climate changes. And above all the fact that today we globally consume 1.6 times the steady state ecological resources, unlike a family that can temporarily live beyond its means. The entire world cannot do that (As the former UN General Secretary noted, we have no plan B since there is no planet B). The societal threats are related to major demographic changes, migration, urbanization, employment insecurity, retirement insecurity and growing inequality in income distribution. The environmental and societal threats to humankind grew as a result of focusing merely on the economy and on economic growth: nations are still striving to increase their GDP, and firms concentrate on increasing their (short term) profitability and wealth. So at present we serve the economy rather than having the economy serve our values.

Metrics do not merely serve as a tool for measuring results. They actually act collectively as a compass, as a dashboard, leading us on our way! Using inappropriate metrics leads us to the wrong directions. There is no way we can solve a problem by sticking to the same principles that created it. In order to move the world to a corrective path, there is an urgent need to stop neglecting non-economic dimensions. In other words, there exists a need for the world to redefine basic metrics by adding non-economic dimensions to the "dashboard". Embracing such a metric creates a paradigm shift from an industrial world to a post-industrial world. We must replace the current sole goal of "maximization of economic values" with a multi-dimensional framework that besides Economic attempts to reach also, Societal, Environmental and Consciousness considerations ("ESEC").

Attempts to mitigate climate changes, to handle environmental issues, and to correct societal issues require united global efforts, and have started already at the Rio 1992 UN Summit. But only the 2014 agreement between China and the USA, the two countries that are responsible for more than a third of the global pollution, paved the way for the 2015 Paris Accord.

The UN suggested a new set of 17 quantitative and qualitative Sustainable Development Goals (SDGs) that could serve as a new metric. Maybe it is not the ideal metric, but we cannot let the excellent be the enemy of the good. At the end of 2015, 193 states accepted and committed to reach these targets by 2030. These ambitious targets require major efforts.

The relevant planning horizon of most leaders and executives is quite short. Moreover, they typically think in terms of hundreds of millions or billions, but seldom in terms of trillions of dollars. Leaders and executives must learn to operate on a completely unrecognized 1000X scale where more and large infrastructure projects have to be initiated and built within a short period. In order to achieve the committed targets by 2030, there is a need to reach in the near future, say by 2020, an interim goal and change the scale of thinking, from $ billions to $ trillions (we call it "from B to T by 2020") and acquiring the needed managerial skills and tools to activate the reform. If we do not accomplish this interim goal by 2020, there is no chance to reach the committed outcomes by 2030 as we are talking about big projects that typically take long planning and building periods. These processes must be started as soon as possible. Reaching the goals by 2030 is quite ambitious. And a delayed start means even harder efforts. A day may come when it will be impossible to achieve the goals, and it will be beyond a point of no return. This is only the first phase, yet a critical and urgent stage in the corrective path.

The educational challenges at this stage is centered on the need to train the leaders and managers, the engineers and designers, the accountants and planning and strategic departments. The above call for a transformation, a paradigm shift, cannot be realized with the tools of the old paradigm. It can happen only with new managerial tools. This by itself is an ambitious and enormous mission to meet. The only way to do that is by first training the leading consulting firms and the large accounting firms, with the help of the older business mentors who know how to make a transformation happen quickly, and then to join forces in preparing the leaders and executives. We know how to do that. At YK Center, we have the right international teams of senior business mentors and experts and have developed tools for what we call "Trans-Form-Nation". This is a method to prepare governments and large organizations to deal with these challenges effectively and with urgency. Due to the very frequent changes around us, the planning stage has to be very flexible. Therefore, the common approach that allows only continuous and smooth passage from the present to the future has to be replaced in a reverse direction: from the future to the present. In other words, it is important to redefine the (multi-dimensional) vision and values, and then agree on the desired future. Then there is a need to identify the obstacles and to find ways to deal with them. This educational approach ends up quickly with major breakthroughs (either things that were defined at first as impossibilities, or things that were not thought about earlier).

Most people have a natural tendency to fear and resist change. That fear is augmented by a weird term like "paradigm shift" that involves thousands of changes. Despite the fears, this may be complex, but not complicated! It simply requires a new way of looking at things! Those of you that watched the movie *Avatar* probably remember the situation where the hero, living in sort of a black and white two dimensional space, is transformed into an amazing colorful three dimensional world. The audience experienced the transformation by merely wearing special glasses.

Assuming that the end result will be achieved and humankind will manage to prevent the catastrophe in time, there are two additional educational challenges. One is to reach the fourth SDG— i.e., the education quality goal. And the other is developing the very young generation.

In order to meet the 4th SDG, we are developing Edu-Coaching programs with collaboration of many educational institutions: elementary, secondary and vocational schools as well as universities. In the past teachers had the knowledge and also the experience that was useful for the future. Now the students have access to all the knowledge in the world and the experience is quite irrelevant for the new economy. One of the goals is to reach the higher level of speech that comes from the frontal part of the brain, rather than from the ancient brains, as this brings to much better joint operation, driven by logic and better control, where the instinctive reactions are suppressed most of the time.

The education of very young generations (kindergarten kids) is also important. At that age children can absorb easily the ability of using the higher level of language, and at the same time they can be guided to use their inventive powers and be attracted to study sciences. So that later on they will love to study the more advanced sciences. And will be good at it. What you learn at a very young age imprints on your behavior and attitudes for the rest of your life (the Jews used to teach very young kids to read and write a few languages at very young ages, and rooted the basic religious ideas in their minds).

The paradigm shift requires immense investments, trillions of dollars per annum. We have a possible solution to where the money could come from. This is less relevant for the current presentation but just for satisfying the curiosity we shall devote a few words to our suggestion. The only potential sources for long term financing are (1) the public sector (governmental budgets and especially social security programs), and (2) the pension plans, retirement and saving programs, and long term life insurance products of the private sector. The financial institutions of the private sector currently manage for their customers an immense portfolio of approximately $80T. That money was the basic target and motivation for the PRI and PSI initiatives during recent years. Unfortunately, in a world of very low (near zero, actually) interest rates, there is little incentive to save money and little appetite to finance impact investments.

Everybody must understand the key role of interest rates in creating attractive retirement plans. High yields are a necessary condition for attracting higher savings and for enabling higher investments. If we can identify investments with high yields (and I will show that we can do that) then we will be able to create an accelerating self-propelling cycle: higher returns on a retirement plan's portfolio will enable the offering of attractive retirement schemes. This, in turn, will motivate larger long term savings, and thereby will enable the financial institutions to finance more impact investments. As long as these investments continue to yield high returns, this self-propelling cycle will continue.

Is it possible to generate such a self-propelling cycle? Assume that a private investor decides to build a solar power station. The only revenue stream the investor sees comes from the sale of electricity. However, if that investment were done by the public sector, it would have created a much higher yield as—from the public's point of view—there are additional direct and indirect benefits; public investments are tax exempt and, in addition, when measured correctly, the public would see other benefits like reduced carbon emissions, positive impact on population, health, job creation, etc.

Therefore, funded social security plans can easily be adjusted to offer a high implicit rate of return on their old age pensions.

Directing private insurance portfolios toward the same target is, however, somewhat more complicated. From the private sector's point of view, most of the societal and environmental costs and benefits are regarded as "externalities" and are often not considered by private industry decision makers. In order to synchronize private sector decision making with the public interest, and in order to be able to offer higher rates of return on the investment, there is a need to "internalize (endogenize) the externalities". There are many ways to do this. It is possible to use certain market mechanisms (such as pollution trading options) and to benefit the private investors by other mechanisms (through taxation, subsidization, public guaranties for minimum yields, etc.) depending on local circumstances and on ideological differences.

Many ideas can be adopted by studying the solutions that were used a few decades ago (typically after WWII) by many countries in order to finance infrastructure projects that were necessary to fuel economic development. The Israeli example is especially relevant in this case. Soon after Israel was established, the government coffers were empty due to the cost of the War of Independence together with the unusual challenges of absorbing a huge number of Jewish refugees that were expelled from Arab countries as well as holocaust survivors from Europe. The population was very young and there were no jobs. There was an urgent need to invest in infrastructures, factories, houses, creating jobs and having to deal with "melting pot" educational challenges. The government decided to do that by encouraging creation of insurance and pension arrangements as well as by establishing a social security system to take care of the population that would reach retirement several decades later. The government issued to the retirement institutions long term bonds bearing high yields and tax arrangements that enabled these institutions to offer very attractive retirement plans, bearing high yields to the savers. This created a very high savings rate in the country. In addition, the government introduced a funded social security plan that invested its funds in quite similar governmental bonds. Funds raised through these special long term bonds fed a "development budget" (separate from the government regular budget) that activated a number of specialized sectorial development

banks that made the investments. This had been the major tool for financing the country's growth during its first four decades. Many countries, especially the developing ones, can learn from this example and can adapt it to their needs by this public-private joint effort. People may relate to this as "subsidies" but in most cases it is merely bringing back to the surface the mismeasurement of the performance that resulted from the exclusion of the external benefits from the traditional financial yield calculation.

Such ideas may, of course, face ideological criticisms as people often resist governmental intervention in the economy, as well as mistrusting government willingness and ability to honor long term goals. Therefore, many people prefer to have privatization at any cost. It is the classic debate between the late Prof. Milton Friedman's approach that "the purpose of business is merely business" and neoclassical economists that support a certain degree of government intervention in the economy, especially as the pure capitalistic theory is an unrealistic utopia. As another Nobel Prize laureate, Prof. Joseph Stiglitz noted: "The 'invisible hand' is invisible since it is not always there." Capitalism does not always reach the desired theoretical optimal solutions because of lack of free competition, the existence of externalities, and the fact that some elements (e.g., "the commons" like air, natural resources, natural values, etc.) are not fully represented in the determination of equilibrium prices. Therefore, there is a justification for some intervention in the pure capitalistic system.

Opponents of any governmental intervention typically emphasize the potential inefficiency and even corruption of governmental systems. But the popular attempts in many countries in recent decades of privatizing governmental activities at any cost had exposed similar inefficiencies in the privatized industries. These actions were often discovered as means for transferring important and valuable public properties at low prices to private hands. Also in the Israeli case that I mentioned earlier, there were complaints about certain distortions in capital allocation, inefficiencies and even corruption cases despite the efforts to run a very "clean" system. A certain degree of disorder seems to exist in both governmental and private systems around the world, and can be prevented and mitigated by education, regulation and efficient control of the market.

Now, when almost all countries have adopted the new metrics—the SDGs—and have committed to reach these goals by 2030, it is time to mobilize these programs. We showed above how a country can do what an individual cannot—lift itself off the ground by pulling its own bootstraps! These mechanisms can be established and activated within a short period, and can be used to simultaneously treat at least three major and pressing global challenges: mitigation of major social and environmental threats through the appropriate impact investments, creating jobs and reducing the job insecurity of Millennials, and reestablishing retirement security for Millennials and future generations. In short, hitting several ambitious and extremely urgent targets with a single arrow!

Can we do this "Trans-Form-Nation"? Yes, We Can!

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Transforming Education for a Transition into Human-centered Economy and Post-normal Times

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Abstract

Solutions to the major problems of our time require a radical shift in our perceptions, thinking and values. Post-normal times (characterized by complexity, chaos and contradictions), post-normal science (characterized by uncertainties, systems view of thinking, alternative perspectives, unknown unknowns, values) and human-centered economy are conceptions that we need to take into consideration to define a new role for science. Managing the transition from the knowledge economy (mainly dominated by the use of analytical skills) to human-centered economy (mainly dominated by the use of creativity, character, passion) requires visionary leadership and a wide range of partnerships, and developing new and more comprehensive, flexible, innovative models of learning. Education today should prepare current generations for the continuously changing world of the future. The critique on modern education ranges across the political spectrum (from 'the Right' to 'the Left'); across countries (both 'western' and 'non-western'); across genders (within men's, queer and feminist movements); and across worldviews (e.g. post-modernism, critical theory, neo-Marxism, critical traditionalism). These critiques all imply that 'modern' education has now become 'outdated' (Milojevic, 2005). Technology and globalization are significantly transforming work. However, education and training systems, having remained mostly static and under-invested in for decades, are largely inadequate to meet the needs of the new labour markets. How the disconnect between education systems and labour markets can be eliminated is a much disputed topic and it may require a paradigm shift in current thinking. Citizens and consumers today are experiencing a growing sense of alienation, loss of values and flexibility (Zajda, 2009). There is no form of education which would meet different needs worldwide. Education is a basic human right and it cannot be purely demand-driven. Diversity of educational models, even within a given country, is something that should be encouraged (Chuan, 2015). The main aim of this paper is to discuss and show the need for new alternative education systems which could eliminate the basic deficiencies of the current systems in the post-normal times. Citing the main reasons behind the necessity for formulating new ways of thinking and using them in the formulation of new education policies is another aim of the paper. The know-how and analytical skills that have made people indispensable in the knowledge economy will no longer give them an advantage over increasingly intelligent machines. Employees in a human-centered economy will need to possess values like creativity, character, passion and collaboration that cannot be programmed into computer traits. Our human qualities will set us apart from machines and make organizations superior (Seidman, 2014). The fundamental gap between the clear success of knowledge acquisition in the natural sciences versus the rather minimal success in understanding the dynamics of the social realm is the inherent non-linearity, instability, and uncertainty of social systems' behaviour. There could be possible alternative ways of closing this gap. Today we need deep ecological ethics, especially in science. Sometimes what scientists do is not life-furthering and life-preserving, but life-destroying. The systems view of life (the whole is bigger than the sum of its parts) may overcome the Cartesian metaphor. Physics, together with chemistry, is essential to understand the behaviour of the molecules in living cells, but it is not sufficient to describe their self-organizing patterns and processes. Every system, every part of it, is connected to every other system, at least indirectly. Systems and parts of a system interact in ways that can produce surprising and counter-intuitive results. The tendency to produce unexpected results makes predicting the outcome of systems' interaction difficult, if not impossible. If we think that understanding parts allows us to understand the whole, we may reach wrong conclusions. The whole is bigger than the sum of its parts. In post-normal times we need to teach people how they can be more antifragile and enjoy the complexity of daily life. This is another attempt to show that we need a reconsideration of the relevance of the certainty and stability of the Newtonian paradigm with respect to all natural and social phenomena.

1. Introduction

As the twenty-first century unfolds, it is becoming more and more evident that the major problems of our time—energy, the environment, climate change, food security, financial security—cannot be understood in isolation. They are systemic problems, which means that they are interconnected and interdependent. Solutions to the major problems of our time require a radical shift in our perceptions, thinking and values (Capra and Luisi, 2014).

Economics, which ought to be a science for human emancipation, has become a dehumanized expert ideology remote from people's practical concerns and their ability to understand what to do (Hart et al., 2010). Hart and others also explain the meaning of a human-centered economy in their book. According to their explanation, calling the economy "human-centered" means putting people first, placing their thoughts, actions and lives as the main concern of economy.

The age that we are living in is called more frequently as "post-normal times", which is characterized by complexity, chaos and contradictions (Sardar, 2010).

Of course, there are solutions to the major problems of our time; some of them could even be simple to solve. However, most require a radical shift in our perception, thinking and values.

As Capra and Luisi argue, solutions are those that are sustainable. A sustainable society must be designed in such a way that its ways of life, businesses, economy, physical structures, and technologies do not interfere with nature's inherent ability to sustain life. Unfortunately, the object of an economy gradually moved from human well-being to merely making more and more money (by producing and selling things).

To transform the knowledge economy to a human-centered economy, how we can redesign standard education is another important question. The world is changing very rapidly and this requires teaching different content and ways of thinking to people to prepare them for unknown unknowns and uncertainties of our time.

As Bertrand Russell has written in *Education and the Social Order*, education is desirable for all modern civilized states. People and states can attribute different meanings to it and there are as many divergent views on "how it must be designed or organized". It is easier to answer "why it is desirable and why it is one of the most important topics in the political agenda of almost all states". It is believed that through this way a significant improvement can be achieved in human welfare.

Still there is no consensus on "what kind of curriculum will prepare graduates for an uncertain global future". As it is highlighted in "the 2006 UK Professional Standards Framework", students are now valued for their independence, openness of mind, creativity, and problem-solving skills.

Compulsion in education may destroy originality and intellectual interest (Russell, 2010). The education system should make lessons voluntary, lay emphasis on spontaneity, create natural curiosity, especially to embrace the world's complexity today. We need different forms of citizenship, different ways of understanding individuality and cooperation. Getting ready for an uncertain future and improving the sense of obligation to wider communities may require radical changes in the design and content of the current education system.

After introduction, in the second part of the paper, the possible and probable necessities of new designs in the education system and new ways of thinking will be discussed. In the third part of the paper, the basic assumptions of today's orthodox economic theories, namely "rationality" and its limits, and decision making under uncertainty and post-normal times will be discussed.

Post-normal Science is a new concept of complexity science related issues and focuses on aspects of problem solving that tend to be neglected in traditional scientific practice: uncertainty, value loading, and plurality of legitimate perspectives (Funtowicz & Ravetz, 2003).

And finally in the fourth part, cybernetics, chaos and complexity concepts will be discussed.

There are lots of questions to which lots of different replies can be given. Do we need a uniform system of education (similar universities–similar courses–similar contents), do we need the same framework, do we need to formulate everything with a mechanistic view of old times? Do we need uniformity or diversity?

New problems of the world and complexity of decision making may require deviations from formal methods and a standardized curriculum.

A new scientific conception of life can be seen as a broad paradigm shift from a mechanistic to holistic and ecological worldview. A new conception of life involves a new kind of thinking—thinking in terms of relationships, patterns, and context.

In science, this way of thinking is known as "systemic thinking" or "systems thinking", which aids our understanding of life (Capra and Luisi, 2014). It is time to teach students about cognitive biases. It is time to teach them new ways of thinking. It is time to teach them how to decide under complex and chaotic situations and also how they can learn from their mistakes and become more antifragile. It is time to teach them how to cope with the main problems of the post-normal times.

2. Education and Thinking

2.1. Education

To understand the requirement of new tools to solve the new problems of post-modern times we will start with traditional definitions of "education" and "science".

The word 'education', which "is derived from educare (Latin) 'bring up,' is related to educere 'bring out,' 'bring forth what is within,' 'bring out potential' and ducere, 'to lead'" (Bhatt, 2017).

So, the word 'education' in a broad sense refers to "any act or experience that has a formative effect on the mind, character or physical ability of an individual. In its technical sense, education is the process by which society deliberately transmits its accumulated knowledge, skills and values from one generation to another" (Eurostat, 2017).

Education is not always about the capacity to think, but the choice of what to think about. (Chou, 2017).

Science is a body of empirical, theoretical, and practical knowledge about the natural world, studied by scientists who emphasize the observation, explanation, and prediction of real world phenomena.

So, education is generally taken as a transmission of knowledge and ideas. But how they can be applied to our daily life is a missing part. There is an urgent need to connect academic studies with the real world.

Whether uniformity in education is good for learning is a disputed topic. Generally, there are two sides to any debate. There could be some good arguments for uniformity such as efficiency, which may require some consistency in the process of educating large numbers of people. Some educators think that creating general standards and equality across schools, districts, and states might be a fair approach.

But lots of possible benefits of diversity are expressed by educators as well. Teachers' experiences prove that students learn in different ways. There are differences in learning styles, cognitive styles, psychological types and there are multiple intelligences. So, the need to address the imbalance between uniformity and diversity is widely highlighted by educators (Baofu, 2011).

As expressed by a well-known quote, "Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid"*.

Education is structured as a uniform standardized format and in many systems it does not allow for self-directed individual exploration. Many education systems are based on competition.

A number of recent studies have shown that in many developed countries happiness is not proportionate to economic wealth. Moreover, the unfettered competition and concepts of modern life may lead to serious damages to our mental health. Mental health is defined as the emotional resilience that enables us to enjoy life and to survive pain, disappointment and sadness, and an underlying belief in our own, and others' dignity and worth. It also allows us to engage productively in and contribute to society or our community (Universities UK, 2015).

To transform and prepare our education system for the transition into a human-centered economy, we should start questioning the basic assumptions of current economic theory. The theory needs to validate that wealth is a poor indicator of happiness. Also, it should take into account that making mistakes is the key to making progress (Dennett, D.C. 2014).

The main aim of education should not be to find ways to know the future, but rather to find and teach ways to live and act in a future characterised by uncertainty.

2.2. Thinking

Over the course of the 20th century, the mature economies of the world evolved from "*industrial* economy" to "*knowledge* economy". Now we are at another watershed moment, transitioning into "*human-centered* economy" and the shift has profound implications for the field of management (Seidman, 2014).

In his article, Seidman explains the "human-centered economy" concept in a clear way. He explains the stages through the work that people predominantly do in them. The industrial economy replaced the agrarian economy when people left farms for factories; then the knowledge economy pulled them from factories to office buildings. When that happened, the way workers added value changed, too. Instead of leveraging their brawn, companies capitalized on their brains. No longer hired hands, they were hired heads (Seidman, 2014).

Intelligent machines, the developments of artificial intelligence, and the use of virtual reality may appear to dominate over the analytical skills of humans. However, humans' creativity, passion, character, collaborative spirit, their humanity will make them superior and distinct and these skills cannot be programmed as software.

In the human-centered economy, the most valuable workers will be hired hearts. The new paradigm shift requires the use of new contents and curriculum which necessitate improving abilities and strengths.

As Keynes said, "The difficulty lies, not in the new ideas, but in escaping from the old ones." Prediction and probability are limited ways of thinking about the future.

Questions about the origin/nature and meaning of life are as old as humanity itself. They lie at the very roots of philosophy and religion.

The act of thinking produces thoughts. A thought may be an idea, an image, a sound or even an emotional feeling that arises from the brain.

According to the systems view of thinking, every system and every part of a system are connected to every other system, at least indirectly. Systems and parts of a system interact in ways that can produce surprising and counter-intuitive results.

The tendency to produce unexpected results makes predicting the outcome of systems' interaction difficult, if not impossible.

A unified systemic vision includes and integrates life's biological, cognitive, social, and ecological dimensions, and also sees the philosophical, spiritual, and political implications (unified view of life).

A shift in metaphors is needed—a change from seeing the world as a machine to understanding it as a network.

Since the time of early Greek philosophy, there has been a tension between mechanism and holism.

From a historical perspective, we first observe the extensive use of Cartesian mechanism (from 17th to 20th centuries) and then we observe the rise of systems thinking and now researchers are working on the development of complexity theory and chaos theory. These changes also bring about new ways of thinking.

* Although this quote is used in association with Albert Einstein, some claim that Einstein did not say it.

Leonardo da Vinci (1452-1519) was different from others and he developed an empirical approach involving the systematic observation of nature, reasoning, and mathematics as the main characteristics of the scientific method.

The shift from the organic to the mechanistic worldview was initiated by Rene Descartes (1596-1650) (Cartesius is his Latinized name).

We observed the rise of Cartesian mechanism (from 17th to 20th centuries). Copernicus, Kepler, Galileo, Bacon, Descartes, Newton and others held a mechanistic view.

The first strong opposition to the mechanistic Cartesian paradigm came from the Romantic Movement in art, literature, and philosophy in the late 18th and early 19th centuries.

Johann Wolfgang von Goethe (1749-1832), a central figure in this movement, conceived of form as a pattern of relationships within an organized whole, a conception which is at the forefront of systems thinking today.

The 1940s saw the formulation of actual systems theories. These first theories, which we may call the 'classical systems theories,' include in particular general systems theory and cybernetics.

But still, not only in natural sciences but also in social sciences there is a tendency to resort to mechanistic view of thinking. Changes in paradigms occur in discontinuous and revolutionary breaks which are called paradigm shifts, according to Thomas Kuhn. We need a paradigm shift in our ways of thinking.

When we look at our modern industrial culture, we have overemphasized self-assertive thinking and neglected the integrative tendencies. We may observe this both in our thinking and in our values. Self-assertive values are competition, expansion, domination. In patriarchal societies, they are not only favoured but also given economic rewards and political power. This is one of the reasons why the shift to a more balanced value system is so difficult for most people.

However, there is another kind of power, one that is more appropriate for the new paradigm—power that comes with the empowerment of others. This power does not arise from hierarchy but from the network, the central metaphor of the ecological paradigm.

In a social network, people are empowered by being connected to the network. Power as empowerment means facilitating this connectedness.

THINKING		**VALUES**	
Self-assertive	Integrative	Self-assertive	Integrative
Rational	Intuitive	Expansion	Conversation
Analysis	Synthesis	Competition	Cooperation
Reductionist	Holistic	Quantity	Quality
Linear	Non-linear	Domination	Partnership

Instead of self-assertion, we should teach students to use integrative thinking. In a similar way, instead of encouraging rational thinking, we should encourage intuitive thinking.

As for values, we should teach the basic benefits of cooperating with others, why we need to prefer quality over quantity, and why especially in management sciences we should teach the benefits of partnership over domination.

Educational policymakers should also think about "how we can change the way people think about things".

Thinking in new and interesting ways will give us better results in this complex and chaotic world.

People are pretty good at anticipating continuous change and most changes are continuous such as getting older, growing the economy, warming the planet. The opposite is true for discontinuous change. It happens so suddenly that there is little time to adapt.

The Postmodern Condition by Jean-François Lyotard was one of the first books that began to question the very status of science. Lyotard used the term "intractable" to mean that some areas of study, of experience, are simply too complex or too random to be predicted or understood. His conclusion was not anti-science but he wanted to show that there are many areas of life that will always remain intractable to science like the self. The central instrument of contemporary science is "reason".

Nietzsche called this "the paranoia of reason" and Lyotard preferred the "tyranny of the experts". Lyotard, influenced by Werner Heisenberg, Kurt Gödel, and Thomas Kuhn, was impressed by the new ideas of the late 1970s and 1980s, in particular catastrophe theory, chaos theory, and the problems posed by incomplete information, 'fracta' (Watson, 2002). He claimed that the very meaning of knowledge is changing and it is producing not the known but the unknown.

Many philosophers tried to show that there are some natural, universal, constant things but there are also conventional, local, variable things in life.

According to Yuval Harari (Homo Deus, 2016), in medieval Europe, the chief formula for knowledge was: Knowledge=Scriptures x Logic. To answer a question people read manuscripts, and used logic to understand the exact meaning of the text.

The Scientific Revolution proposed a different formula for knowledge in which Knowledge=Empirical Data x Mathematics. If we answer a question, we need to gather relevant empirical data, and then use mathematical tools to analyse the data. Harari accepts that this formula led to many successes in astronomy, physics, medicine and other disciplines. But he highlights a very important drawback: it could not deal with questions of value and meaning.

He offers another formula in which Knowledge=Experiences x Sensitivity. If we want to know the answer to an ethical question, we need to connect to our inner experiences, and observe them with the utmost sensitivity (paying attention to our emotions and thoughts).

Many scientists, researchers and thinkers suggest different and novel ways to change our view of thinking and values in post-normal times and many of them agree that we need a radical change in our views.

This is a very vital conclusion that must be dealt with seriously and understood by policy- and decision makers.

3. Rational Irrationality Problem & Decision Making in Post-normal Times

3.1. Irrationality of Rationality

The world is changing. It seems the world will be directed from many places and by many people. The new era can be called a multi-polar world (Zakaria, 2009).

World history is full of economic, social and political crises. We live in a world that is characterised by unpredictable events which we cannot control (Banerjee, Ercetin and Tekin, 2014).

Traditional economic theory assumes rational actors exist. Economists are using models that replace Homo sapiens with a fictional creature called Homo economicus. Contrary to the fictional world of Homo economicus, humans are not perfect, and make a lot of bad predictions (Thaler, 2015).

The contributors of chaos theory showed us that the certainty and stability of the Newtonian paradigm must be reconsidered. With the focus of chaos theory on non-linearity, instability, and uncertainty the application of this theory to the social sciences is essential and must replace the dominant Newtonian view of a mechanistic and predictable universe.

Science is characterized by "certainty" and "value neutrality". Of course emerging environmental issues do not render the use of traditional scientific approaches irrelevant, the task is to choose the appropriate kind of scientific problem solving strategies (Funtowicz and Ravets, 1994).

Empirical evidence shows ways in which our judgements and decisions differ from rational choice theory. At its most basic level, behaviour is rational if it is goal-oriented, reflective and consistent (across time and different choice situations).

"Rationality" can be defined in different ways. In business dictionary it is stated that the mental state of a rational person is characterized by (1) beliefs that are coherent (not contradictory) and compatible with the person's experience within a given context, (2) purposeful (intended to produce certain results) behaviour guided by means versus ends analysis, (3) decision making based on cost-versus-benefit (pain versus gain) evaluation, and (4) an overall optimization approach (utility maximization) expressed by attempts to maximize advantages or gains and to minimize disadvantages or losses (Business dictionary, 2017).

Daniel Kahneman and Amos Tversky introduced the idea of cognitive biases and their impact on decision making in 1974. A forerunner of Kahneman and Tversky was Herbert Simon. He wrote about what he called "bounded rationality". People, he said, lack the cognitive ability to solve complex problems (Thaler, 2015).

In a similar way, "Bounded Rationality" is defined as follows: It is the conception that decision makers (irrespective of their level of intelligence) have to work under three unavoidable constraints: (1) only limited, often unreliable, information is available regarding possible alternatives and their consequences, (2) the human mind has only limited capacity to evaluate and process the information that is available, and (3) only a limited amount of time is available to make a decision. Therefore, even individuals who intend to make rational choices are bound to make satisfying (rather than maximizing or optimizing) choices in complex situations. These limits (bounds) on rationality also make it nearly impossible to draw up contracts that cover every contingency, necessitating reliance on rules of thumb (Business dictionary, 2017).

George Ritzer explains that in the McDonaldization of Society there are reactionary irrationalities that come out of the hyper-rationality of modern bureaucratic structures.

Peter Kaufman (2012) expressed the main problems of bureaucracy and rationality. He wrote: "*George Ritzer based his idea on Max Weber's theories of bureaucracy and rationality. Weber was concerned that capitalism and industrialization were fuelling a world where our individual freedoms were being eroded. He warned that we were increasingly living in an iron cage, as we become trapped in an impersonal world that values efficiency, rationality, and control over individuality and autonomy.*"

Ritzer's theory of McDonaldization of society has four dimensions: *Efficiency*: Completing tasks in the most productive and proficient manner. *Calculability*: Being able to quantify the output; emphasizing quantity over quality. *Predictability*: Ensuring that tasks, results, and products are always the same. *Control*: Replacing human efforts with non-human technology.

He concludes that when we try to become more efficient, calculable, predictable, and controlling, we often end up with illogical, counterintuitive, and problematic results (we become more irrational).

Ritzer saw irrationality as a side effect of over-rationalized systems. He also cited that a rational system may result in events or outcomes that are neither anticipated nor desired, and in fact, may not be so good (McDonaldization, 2017).

Uriel Abulof (2015) argues that rationality has become an "essentially contested concept," as its "proper use inevitably involves endless disputes."

He identifies "four fronts" for the disputes about the meaning of rationality:

1. The purpose or function of rationality: Is it descriptive/explanatory, prescriptive or subjunctive (rationality "as if" real)?
2. The subject of rationality: What, or who, is rational: the choice, the act, or the choosing actor?
3. Cognition: What is the quality of the cognitive decision-making process: minimal (calculative intentionality) or optimal (expected-utility)?
4. Rationale: Is rationality merely instrumental, that is, agnostic about the logic of human action and its motivations (instrumental rationality) or does it substantially inform them (substantive rationality focusing on material maximization)?

So what we need to understand by rationality is not very clear. The formal definition of Rational Expectations is, the subjective probability distribution regarding future reality inside the heads of economic actors coincides with the objective probability distribution operating outside their heads in reality.

According to Thaler and Sunstein (2009), decision theorists (Homo economicus) are rational but humans (Homo sapiens) cannot be.

As stated by Taleb, "The master of all harmful mistakes: Mistaking absence of evidence (of harm) for evidence of absence".

According to David Orrell (2012), the economy is unfair, unstable and unsustainable. That is why economics as a science needs a scientific revolution.

3.2. Decision Making under Uncertainty and Post-normal Times

Both at the macro and micro levels decision-making is very difficult. Almost all decisions are made under a great risk or uncertainty.

These days, current economics literature covers terms of rational irrationality and the illusion of predictability. The world is full of information. Information is more complex, interdependent, hectic, non-linear, co-evolving and less stable.

It is known that the occurrence of extreme events cannot be predicted from past history.

Policy making, decision making and other aspects of the management of complex systems are becoming increasingly difficult. Management philosophies, approaches, and techniques were developed during simpler times. However, complex systems are dynamic rather than static, evolve or are driven into domains of instability, and emerge as new structures. There is now a growing gap or loss of fit between our systems-management capabilities and the real world.

The conception of 'post-normal' was first introduced by Ravetz and Funtowicz.

In his paper (2010) Ziauddin Sardar states that, "*All that was 'normal' has now evaporated; we have entered post-normal times, the in between period where old orthodoxies are dying, new ones have not yet emerged, and nothing really makes sense. To have any notion of a viable future, we must grasp the significance of this period of transition which is characterized by three cs: complexity, chaos and contradictions. These forces propel and sustain post-normal times leading to uncertainty and different types of ignorance that make decision-making problematic and increase risks to individuals, society and the planet".*

He underlined the importance of humility, modesty and accountability to transform post-normal times into a new age of normalcy. For him logic and rationality, the virtues of modernity, alone will not secure us from the challenges of post-normal times.

Decision-making can be regarded as a problem-solving activity terminated by a solution deemed to be satisfactory.

It is therefore a process which is more or less rational or irrational and can be based on explicit or tacit knowledge.

A heuristic is a thinking rule which helps to reduce the effort or cost of finding a solution to complex problems.

Whatever the type of thinking used, we know that people are not rational and they have many cognitive and behavioural biases. Cognitive bias describes the inherent thinking errors that humans make in processing information.

Some of these have been verified empirically in the field of psychology, while others are considered general categories of bias.

These thinking errors prevent one from accurately understanding reality, even when they are confronted with all the needed data and evidence to form an accurate view.

An example is the Bandwagon effect which is the tendency to do (or believe) things because many other people do (or believe) the same. This is related to groupthink, crowd psychology, herd behaviour, and manias.

Confirmation bias is another one which is the tendency to search for or interpret information in a way that confirms one's pre-conceptions.

Apart from these biases, the psychologist Daniel Kahneman has theorized that a person's decision-making is the result of an interplay between two kinds of cognitive processes: An automatic intuitive system (called "System 1") and a carefully planned rational system (called "System 2"). System 1 is a bottom-up, fast, and implicit system of decision-making, while system 2 is a top-down, slow, and explicit system of decision-making. System 1 includes simple heuristics in judgment and decision-making (Kahneman, 2012).

Whichever system is used it is known that human judgment and preference often do not follow the rules of rationality. Even human experts may have an inconsistent set of preferences, which can be problematic when designing a decision support system that attempts to maximize expected utility (Kochenderfer, 2015).

Many executives are surprised when previously successful leadership approaches fail in new situations, but different contexts call for different kinds of responses. Before addressing a situation, leaders need to recognize which context governs which situations and tailor their actions accordingly.

Snowden and Boone have formed a new perspective on leadership and decision making that is based on complexity science. The result is the Cynefin framework, which helps executives sort issues into five contexts:

Simple contexts are characterized by stability and cause-and-effect relationships that are clear to everyone. Often, the right answer is self-evident. In this realm of "known knowns," leaders must first assess the facts of a situation—that is, "sense" them—then categorize and respond to them.

Complicated contexts may contain multiple right answers, and though there is a clear relationship between cause and effect, not everyone can see it. This is the realm of "known unknowns." Here, leaders must sense, analyze, and respond.

In a *complex* context, right answers cannot be ferreted out at all; rather, instructive patterns emerge if the leader conducts experiments that can safely fail. This is the realm of "unknown unknowns," where much of contemporary business operates. Leaders in this context need to probe first, sense, and then respond.

In a *chaotic* context, searching for the right answers is pointless. The relationships between cause and effect are impossible to determine because they shift constantly and no manageable patterns exist.

This is the realm of unknowables (the events of September 11, 2001 fall into this category). In this domain, a leader must first act to establish order, sense where stability is present, and then work to transform the situation from chaos to complexity.

The fifth context, *disorder*, applies when it is unclear which of the other four contexts is predominant.

If we can teach the ways of decision-making under uncertainty and if we can manage to teach counter-factual analysis to students (which means preparing "what if" type scenarios of the future and using collective intelligence for finding possible, plausible answers), they can be more flexible and resilient.

4. Cybernetics

In post-normal times instead of having a mechanistic view of life, we can start teaching complexity and chaos theories to make people more resilient and antifragile against many unknown unknowns of the future. We need to explain the novelties of complexity theory and chaos theory first. Complexity, that is describing objects with many interconnected parts, can now be observed not only in natural events but in many other systems. A tropical rainforest, multi-celled organisms consisting of proteins, membranes, cells, organs are good examples of a complex system. But many other systems important to humans exhibit similar complexities; markets with their varieties of buyers and sellers, groups participating in mutual funds, economies with hierarchies of workers, departments, firms, industries, the internet with users, stations, servers, websites and more (Holland, 2014)

The general systems theory was advanced by Ludwig von Bertalanffy in the 1940s and cybernetics, by Ross Ashby in the 1950s. Bertalanffy recognized that the patterns of organizational characteristics of life are generated by the simultaneous interactions of a large number of variables, but he lacked the means to describe the emergence of those patterns mathematically.

The mathematics of his time was limited to linear equations, which are inappropriate to describe the highly non-linear nature of living systems (Capra and Luisi, 2014).

The field was further developed by Jay Forrester and members of the Society for Organizational Learning at MIT which culminated in the popular book *The Fifth Discipline* by Peter Senge which defined systems thinking as the capstone for true organizational learning.

The social sciences, historically, have imitated both the intellectual and methodological paradigms of the natural sciences. From the behavioural revolution, to applications such as cybernetics, to a predominant reliance on the certainty and stability of the Newtonian paradigm, the social sciences have followed the lead of the natural sciences (Elliott and Kiel, 2004).

The Butterfly Effect is the conception that small causes can have large effects. Initially, it was used with weather prediction but later the term became a metaphor used in and out of science.

In chaos theory, the butterfly effect is the sensitive dependence on initial conditions in which a small change in one state of a deterministic non-linear system can result in large differences in a later state.

The mechanistic paradigm is based on anthropocentric (human-centered) values, and deep ecology is grounded in ecocentric (Earth-centered) values. The holistic (ecocentric) worldview acknowledges the inherent value of non-human life, recognizing that all living beings are members of ecological communities, bound together in networks of interdependencies.

The cyberneticists concentrated on non-linear phenomena like feedback loops and neural networks, and they created the beginnings of a corresponding non-linear mathematics, but the real breakthrough came several decades later with the formulation of complexity theory, technically known as 'non-linear dynamics' in the 1960s and 1970s.

Cybernetics was the result of a multidisciplinary collaboration between mathematicians, neuroscientists, social scientists, and engineers, a group that became known collectively as cyberneticists. To deal with the complex problems of post-normal times, we need a post-normal science which can bring many disciplines together.

When we have chaos we cannot use traditional methods. Chaos is a phenomenon encountered in science and mathematics wherein a deterministic (rule-based) system behaves unpredictably. That is, a system which is governed by fixed, precise rules, nevertheless behaves in a way which is, for all practical purposes, unpredictable in the long run (Feldman, 2012). During the 1980s and 1990s, complexity theory generated great excitement in the scientific community. Traditional curriculum still uses it widely.

Science and standardized curricula need a paradigm shift. It is better to diversify curricula and prepare people for uncertainties of the post-normal times.

N.N. Taleb's suggestion for today's post-normal times and increasing uncertainties of modernity is a good step to start with in the formulation of alternative education systems. In *Antifragile*, he explains how we can move from the fragile to robust and antifragile domain.

He argues that it is better to expect randomness, uncertainty, chaos; there is no need to hide from them. Someone or something is antifragile if it benefits from shocks, thrives and grows when exposed to volatility, randomness, disorder, and stressors and loves risk and uncertainty.

Antifragility is beyond resilience or robustness. The resilient resists shocks and stays the same. The antifragile gets better. If something is harmed by volatility, it is fragile. If something benefits from it, it is antifragile (Taleb, 2012).

5. Conclusion

The age that we live in has seen the most of man-made change. Civilization has been one of the great accelerators of such change. Human skills and natural facts came together to make possible a new order of life based on the exploitation of nature (Roberts, 1997).

In the first stage of globalisation states came closer and cooperated, in the second stage of globalisation companies came closer and cooperated, now in the third stage, individuals are coming closer and cooperating with each other, sharing their knowledge and experiences.

There is a new role for science, both natural and social. The facts that are taught in textbooks used in training institutions are still necessary, but they are no longer sufficient. Most problems we face today have more than one plausible answer and many have no well-defined scientific answers at all (Funtowicz and Ravetz, 2003).

The problem is whether we will allow today's modernization to destroy next generations' world to live or to use today's modernization to improve the quality of the water we drink, the air we breathe, the environment we live in.

Short-termism, quarterly capitalism is used to describe the prevailing practice of managing businesses from one three-month period to the next, and focusing budgets and strategies on the constant effort to ensure that each quarter's earnings per share report never fails to meet projections or the market's expectations (Gore, 2014).

Creativity, individualized education, creative laziness must be taken into consideration by decision makers, leaders and policymakers when designing a new education system.

Learning to live together, tolerance for other cultures, races, religions, skin colours, other creatures, respect for the environment, human rights, animal rights and using collective intelligence, being aware of complexity, learning antifragility, being aware of bounded rationality, using counter factual reasoning, adding philosophy, fine arts and music to Science-Technology-Engineering-Mathematics (STEM) education are some of the new contents that we should concentrate on.

What is our main aim? To maintain the status quo or to be a change maker? We need a paradigm shift in education. We need to change how we learn, earn and care (Zahidi, 2017).

How we can make humanity healthier, happier, cleaner, cleverer, freer and more peaceful than even before is a very difficult question and can have multiple answers. But it can be seen that we need a paradigm shift. We need to place humans at the center of theories.

The Black Swan argument of Taleb (which means low probability but big impact events) shows us that it is better to stop trying to predict everything and take advantage of uncertainty.

As Alec Bourne expressed nicely, "It is possible to store the mind with a million facts and still be entirely uneducated". To live without certainty, deal with complexity and uncertainties, learning and benefiting from our mistakes is of vital importance.

As Franz Hieronymus expressed, "education is not the transmission of knowledge and ideas. It is the training to make use of information and ideas".

We need to leave "outcome-irrelevant learning" situations. People draw whatever lessons they want from history and are reluctant to change their minds in response to new evidence (Tetlock, 2013). To transform our education system, topics such as "decision-making under uncertainty", our cognitive biases, irrationalities, the limits of statistics and mathematical models, how to turn knowledge into decisions must be the dominant content of curricula.

To make people healthier and wealthier, to encounter the current global threats, researchers should develop novel ways to solve real world problems—environmental problems, economic problems, social problems including migration, health problems and development problems of countries. No country today is prepared to pay bills that will be due in the near future.

The global economy has evolved from a material-based economy into a knowledge-based economy but now it is time to transform it into a human-centered economy. The problems of today's post-normal times require a radical paradigm shift in the formulation of most policies, including education.

As Charles Darwin expressed, "It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change".

We are living in the same small world and we must know that "there will be only one future for all of us, or none at all".

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SECTION 9

AGILE LEADERSHIP AND DECISION MAKING – THE ROAD AHEAD

Change Leadership: Leading by Empowering and Innovation

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Abstract

According to Machiavelli, "there is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things." Five hundred years later this is truer than ever before. Today's ever-changing, agile environment is constantly reshaping the way we learn, the way we think and the way we transform ourselves and others in order to adapt or embrace the new order of things, the inevitable change. Usually, we think of change as being imposed on us, but as a leader of change, one faces many more challenges in the process of introducing, conducting and executing change. Today's leaders of change need to have the ability, strength and vision to become catalysts of change. They need to sharpen their transformational and instructional leadership skills, and possess tools to overcome obstacles and empower their followers.

1. Introduction

This paper intends to demonstrate how Effective Change Leadership can facilitate and inspire positive change within the organization. This particular Change Leadership model and its concepts are linked to the local context of Hawaii LTD, DLI with examples of how leading change through innovation, empowerment of faculty and investment in their abilities and creativity dramatically changes the organizational culture, motivates, inspires, and creates a culture where the challenge is embraced by all.

2. From Idea to Joint Vision

2.1. Background

It all started with the Need—meaningful incorporation of technology in language teaching. Our main resources were: faculty and existing curriculum. Our tools: iPads, iBooks Author, widgets, technology and methodology trainings. Timeline 1-3 months for first piloting of new lessons; Timeline 2-6 months for complete re-design of the curriculum.

2.2. Communicating the Needs and the Vision

The first step was to introduce the Need and the Goal. The obvious and immediate need was the application of new technology—iPads and iBooks. This required a complete revising and adjusting of the whole existing curriculum to fit new tools and new way of thinking and teaching in the era of "digital natives"—students vs. "digital immigrants"—teachers. The goal was to use the tools, in this case new technology, in a meaningful way by relying on students' ability to hypertext, employing and promoting their multiple intelligences, using gamification as a concept to encourage students to learn languages, etc. This idea sounded so "out there," it was so innovative, inspiring, and logical, but at the same time very unrealistic and scary for many. Even at the first meeting with the faculty I could see the range of reactions and emotions on their faces, from disbelief to absolute annoyance. I could feel in the air the instant reaction of "Yet another new thing that we have to try!" My excitement and passion about the new adventure we were about to embark on were embraced by some, but definitely not by all and I knew, then and there, that if I wanted the faculty members to accept the idea as their own, it had to be equally shared, and supported through their full participation and commitment.

3. From Resistance to Integration

3.1. Overcoming Resistance

"People don't resist change. They resist being changed!" – Peter Senge

Having a necessity, and an obvious need to execute a change is sometimes helpful at the initial stage, but unless the idea that you have as a leader is truly embraced by your followers, and unless they truly believe that they will equally and fully participate in its execution, the change will not happen the way it is envisioned. Resistance is a difficult yet unavoidable part of change. As good leaders of change we understand the differences of the people we lead and how to use their strengths (Kotter's 8 steps Change Model) so that we can minimize the resistance, but that is easier said than done. In reality, all people resist being changed regardless of their education, age, or background, because the hardest thing to change is our beliefs, attitudes and experiences. "Even those who fancy themselves the most progressive will fight against other kinds of progress, for each of us is convinced that our way is the best way." (Louis L'Amour). That was the case with the Hawaii LTD faculty members who were already successful and experienced, had excellent results, and the students who were satisfied with the courses' outcomes. So, the obvious question in dealing with this change came up: Why should we change anything if everything is working so well? Just as prescribed by Kubler-Ross Model, we went through all stages of resistance: denial (don't fix it if it ain't broken), emotional (problem finding), acceptance (problem solving), and commitment (increase in morale).

3.2. Integration

Hawaii LTD went through the above specified stages in our own way, by integrating each and every faculty at every level of the change process, based on their skills, experiences, interests, potentials and different levels of expertise.

As in the Table 1 below, we went through 3 phases of Integration:

- Innovating
- Growing
- Empowering

4. From Innovation to Empowerment

4.1. Phase 1 - Innovating

In this phase we formed a group of combined experts—tech geniuses (experts in new technology) and academic geniuses (experts in teaching methodology). We trained them on basic hardware and software use and allowed them to experiment. The first lessons were mostly focused on technology per se, but less on the methodology. We re-trained the group on the meaningful use of technology for language learning and let them further experiment and innovate. They first piloted lessons-products in front of other colleagues which inspired and encouraged the rest of the faculty to integrate themselves into the project, and incited them to innovate.

4.2. Phase 2 - Growing

We formed the teams with Mentors from the "Experts" group who trained the rest of the faculty. At the same time, the "experts" continued to be additionally trained in both software (widgets use for example) and methodology. Once all the faculty members were trained, everyone shared their lessons-products and the first lesson was piloted in the classroom. Seeing the excited, proud faces of our faculty members when they realized what an amazing product they made with their own hands and creative minds, and when they saw the immediate results in the classroom, was absolutely priceless and beyond rewarding.

4.3.Phase 3 - Empowering

Once the faculty felt comfortable with innovating with the new technology and proud of the impact and value of their own products they gained the qualities and attributes of a leader. They started recognizing themselves as not just teachers, but also as curriculum designers, innovators, visionaries… They dared to train others, to present what they learned and produced, to write and publish about their experiences and accomplishments.

Table 1: 3 Phases of Integration

Phase 1 - Innovating	Phase 2 -Growing	Phase 3-Empowering
Small group formation	Teams forming (Mentors)	Teacher/Designer
Small group training (Technology & Methodology)	All faculty members training (TTT)	Teacher/Presenter
Small group design experimenting	All faculty experimenting	Teacher/Publisher
Small group modeling	All faculty modeling	Teacher/Innovator
Evaluating	Evaluating	Teacher/Visionary
First Lessons Piloting	Classroom application	Teacher/Catalyst for future change
Re-evaluating	Growing	Empowering

5. Conclusion

Giving everyone a chance and the freedom to be innovative and creative in their own way and at their own pace is the crucial ingredient to creating a happy and motivating work environment. When your creation is a product of your brain and your heart, that is when you feel true ownership. That ownership becomes a seed of the growth, empowerment and pride that you want to pass on.

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Agile Management Education for the Future: The Role of Social Capital & Trust

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Abstract

Forecasting the future trends in any area becomes more and more frustrating in view of the accelerating pace of change in all components of reality resulting in unprecedented complexity of possible impacts. Hard times call for unstandardized solutions as to how to stay accountable for numerous stakeholders in the business roadmap to the future when the value of traditional management theories and concepts in turbulent environment is undermined and performance is endangered. Common rationality gives two practical solutions: building resistance to shocks and agility to take advantage of perceived opportunities and available resources. When interviewing managers on their strategic imagination and trust factors one can find too limited perspectives, reduced creativity and real capability to respond to problems on time. This paper is aimed at showing the role of soft factors such as social capital and trust as the base for meaningful moves allowing for integrated actions. To properly address the future challenges and use the proper tools in defining goals, strategies and execution a whole new set of management competences and new forms of managerial education with more team-based business-driven action learning and design thinking are needed.

1. Introduction

Agile becomes one of the hottest words reflecting the deep need to adjust the mindset and activities of people to the accelerating pace and complexity of change in the relative task environment in order to achieve expected results.

The origins of the agile movement are routed in the software development failures caused by the use of traditional iterative models of IT project management assuming that the proper execution of plan would eliminate the need for change. Alongside with the increase of uncertainty new project management life cycle models were elaborated: agile, adaptive, incremental, and extreme (Wysocki 2012). Agile family of tools addressed the situations where not only the process was uncertain but even the goals were vaguely imagined (Cobb 2011).

The breakthrough came in 2001 with the Agile Manifesto declaration, whose 17 authors proclaimed four key values, and 12 principles for software development. Those values put individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation and responding to change over following a plan. The 12 principles were recommended:

1. Satisfying 'customers' through early and continuous delivery of valuable work.
2. Breaking big work down into smaller components that can be completed quickly.
3. Recognizing that the best work emerges from self-organizing teams.
4. Providing motivated individuals with the environment and support they need and trust them to get the job done.
5. Creating processes that promote sustainable efforts.
6. Maintaining a constant pace for completed work.
7. Welcoming changing requirements, even late into a project.
8. Assembling the project team and business owners on a daily basis throughout the project.
9. At regular intervals, having the team reflect upon how to become more effective, then tuning and adjusting behavior accordingly.
10. Measuring progress by the amount of completed work.
11. Continually seeking excellence.
12. Harnessing change for competitive advantage (Beck et al. 2001).

Due to their universal and common sense logic they constituted the framework for agile thinking not only in IT projects but also in general applications including agile management in business, building agile organizations and providing agile education for managing and creating the future.

In particular, the stress should be placed on the continuous process of value creation for clients and all other stakeholders in every venture with the acceptance only of excellent quality. The acting agents are freely organized teams supported by decision-makers at different levels, who also provide necessary resources. The constraining factors stem from the novelty of problems, need for innovative approach and numerous changes to deliver results in the proper time frame when it makes competitive sense. For such requirements the adequate communication and controls—as an investment in building relations—social capital, are needed to keep the discipline in time and cost management relative to value created. It does not mean the reduced trust and empowerment, just the opposite—the more time invested in building social capital, the higher the trust (Bochniarz, et al 2016). Moreover, every new venture becomes an experiment and platform for action-reflection learning. It allows for climbing up to higher performance levels and achieving maturity in undertaking any new opportunity or eliminating any threat.

As defined by Aaron De Smet: "Agility is the ability of an organization to renew itself, adapt, change quickly, and succeed in a rapidly changing, ambiguous, turbulent environment. Agility is not incompatible with stability—quite the contrary. Agility requires stability for most companies" (De Smet et al. 2017). Agility is typical for great, creative companies with cutting-edge technologies. The research of McKinsey Company shows that: agile companies are numerous; they are of all sizes, in all industries, even very traditional (McKinsey 2017).

In this article the stress will be on social capital and trust as prerequisites for successful work-out of the ventures as components of long-term strategies and continuous delivery of expected results taking into account emerging risks. To prepare cadres for these new challenges managerial education should also change from well-structured areas of knowledge, to a discovery-type of process in defining strategy and its agile execution based on design thinking creative approach and a new set of competences. The key success factors are trust and collaboration in teams when defining challenges and problems or searching for feasible solutions. They should be followed with the responsible decisions of managers aimed at meeting expectations of diverse stakeholders, building resistance to crises and capabilities of fast responses to profit from identified temporary opportunities.

2. Challenge to Business Management: The Role of Projects

The contemporary world permanently creates pressures on management on how to transform an ephemerid situation into valuable and sometimes durable results in the form of products, services, and solutions we need to sustain and grow. What tools help us achieve success when we operate in more and more open systems where uncertainty reigns?

According to Harold Kerzner it is Project Management (PM), which for a long time was not essential for the organizational survival, so the needed prerequisites of the PM success, such as real commitment, empowerment, teamwork and trust were evidently lacking and cannot be substituted by mastering technology. In the mid-1990s two recessions made it clear: that change was inevitable. It altered the perceptions: change may be good, conflicts—stimulating, projects—are not an internal issue but a strategic weapon. Change management through projects resulted in fundamental shifts on the map of excellent and admired companies (Kerzner 2000).

Traditionally, alongside the growth of organizational size and complexity, more standardization was introduced and centralization of major decisions to provide coordination, integrity and control of separate units. Although ICT allows for deep decentralization without losing control of the overall performance, and communication among separate units, still human resources as soft factors are the key players in designing and navigating roadmaps to the desired future.

Projects can respond to the challenges organizations have to face in order to survive in a strongly competitive and turbulent environment. Some of the challenges are: accelerated innovation streams, internationalization and globalization with respect to local and regional differences, fast pace of technology advances, ICT platforms, cloud computing, powerful search engines, connection and cooperation solutions, the emergence of new generations with their specific behaviors and skills, shortening of the product- and the whole industry cycles, a scale-based competition adversary affecting the existence and profitability of numerous businesses, and finally the transient competitive advantages. All these challenges require very effective and efficient projects and processes, which enable the successful execution of any attractive initiative included into the strategic portfolio.

Another emerging trend gaining momentum is sustainability, which calls for intelligent solutions in integrating business, environment and social issues with the support of smart institutions. According to Hoffman (2017), a shift is needed from the reduction of unsustainability (enterprise integration concept) to creating sustainability (market transformation). Responsible and streamlined actions of diverse stakeholders with political support are needed to effectively resolve identified problems and conflicts in this large arena. (op.cit.).

3. Agile Business Response

In general two types of responses have been developed to situations going beyond business as usual: building resistance and resilience to shocks and unavoidable crises, and working with agility to profit from transient opportunities and available resources. There are two stimulating motivations: pessimistic (fear of failure) and optimistic (hope of success). In between them, there is a vast space for creative solutions.

Many of them are already present as organizations moving towards flexibility, innovation and uniqueness vital for competitive battles, networking (clusters) and partnering (alliances, collaborative innovation), getting back to the direct and carefully modeled businesses, customer relationship management (CRM), customer experience management (CEM), integrating the strategy with projects, modern ICT systems, platforms and solutions as well as smart manufacturing. Marketing communication campaigns became a must for market presence. Knowledge became strategic in responding to challenges. The question is whether the above mentioned progress is sufficient to successfully address New Economy rules. Are businesses really agile? What is the road ahead and how to coordinate the pace of business agility with the external impacts of change?

4. Agile Organization

Agile, developed for software team project management, is an empirical control method with transparency in all activities of involved team members, frequent inspections after every iteration (called sprint in SCRUM, the agile method of project management), measurement and evaluation of progress and—in case of problems—immediate adaptation to meet requirements. (Ambler, Lines 2017).

What is feasible for small teams may not be suited to manage large organizations with their strategies, hierarchical structures, rigid processes and rules. The transition to agility for large corporations requires the multistep shift starting from projects and followed by adjustments in other organizational units. Steve Denning (2010) developed the agile way of thinking and acting for radical management. Organizations should build and respect 7 basic inter-locking principles for continuous innovation:

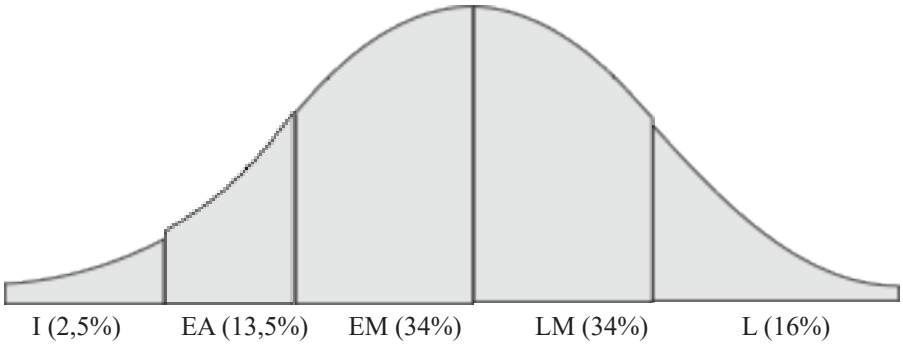
1. The goal of work is to delight clients. The whole organization should focus on it, not just the marketing department.
2. Work is conducted in self-organizing teams. It is the best way to generate continuous innovation.
3. Teams operate in client-driven iterations, because delighting clients can only be approached by successive approximations.
4. Each iteration delivers value to clients. Client-driven iterations focus on delivering value to clients by the end of every iteration. They force closure and enable frequent client feedback.
5. Managers foster radical transparency. Self-organizing teams—working in an iterative fashion—in turn both enable and require radical transparency so that the teams go on improving of their own accord.
6. Managers nurture continuous self-improvement which means having the entire work force find ever better ways to give more value to clients.
7. Managers communicate interactively through stories, questions and conversations using authentic narratives, open-ended questions and deep listening, rather than treating people as things to be manipulated (Denning, 2010). According to Denning, the recorded organizational gains in productivity are 2 to 4 times higher than before, referring to customers' and employees' satisfaction as well as to innovation streams (op. cit.).

Leading companies who usually employ aspiring best cadres and have developed vibrant business ecosystems, started to pursue the radical management and borderless organization concept in the same league as startups striving for growth and stabilization based on innovative concepts. For example, business driven global action learning programs launched by General Electric (GE) helped them to totally rebuild the company strategy and structure, which resulted in their moving from an engineering company to knowledge based creative infrastructural company harnessing innovation from all the resources they possess. The most valuable ones are knowledge, entrepreneurial and determined cadres, and their competences built on broad business experience from global operations.

However, as pointed out by M. Moreira, "adopting Agile is not just the matter of learning skills or understanding the procedure, it is about adopting a set of values and principles that require change in people's behavior and the culture of an organization" (Moreira 2013). For any cultural change it takes time to change peoples' values and behavior so it should be perceived as a journey towards new ways of thinking and acting. The reference is change must be endorsed, internalized and believed to be beneficial. This is the way of institutionalizing the change.

As in the case of technology adaptation lifecycle (Adler, Shenhar 1990) and also in shifting towards agile one can distinguish five types of behaviors: innovators (I), early adopters (EA), early majority (EM), late majority (LM), and laggards (L). Agile still stays a domain of innovators and early adopters, who according to the authors of the classic technology diffusion model, sociologists Joe M. Bohlen and George M. Beal (Bohlen, Beal 1957), respectively in their demographic and psychological features, present specific patterns of behavior. It is illustrated below with respective shares in the whole population of engaging companies (Fig.1).

Fig.1. Attitudes in Adopting Agile (Based on Moreira, op. cit.)



Innovators are educated persons willing to try out new ideas, enjoying innovation, accepting the risk and tolerant of mistakes, paving the way to get innovation to work. They require little guidance.

Early adopters operate on a broader scale; from experiments they move to organized actions as the educated community leaders searching for improvements and interested in visibility and credibility. They accept some level of risk.

Both groups represent a positive attitude to cultural change and fight for adapting innovation.

The biggest progress in accelerating the adaptation of agile in this model refers to an early majority group that is described as being more pragmatic, still open to new ideas but more focused on the controlled way of change management to become successful, while the late majority and laggards rely on the experiences of previous groups and they are least interested in changing their culture.

There are two critical moments in the innovation diffusion process related to agile. As in the case of disruptive innovation there is a radical change of culture (mindset, values and behavior) in two stages of the process. In the case of agile it is between early and late adopters. Next critical moment is when implementers dominate innovators, converting the innovation into a commodity type of product or solution, thus losing its competitive power. There is no clarity as to what will be the next big idea.

Taking into consideration the necessity of sorting out potentially profitable projects to provide decent returns to shareholders and benefits to other stakeholders, more initiatives should be tested, all of them creating the business strategic portfolio. Agile business strategy means applying the SCRUM approach where a set of projects and programs share company resources. The other side of this logic is the rise of internal competition for scarce resources. In the next stage only those stay that at best strengthen a company's mission of delivering value and performance (Sutherland 2014).

Nowadays, when "software has eaten the world" (Gothelf 2014) and is transforming the way of doing business, every company is in "a software business". It does not mean being agile until all organizational subsystems are not able to support the logic of instant solutions and continuous delivery based on communication and learning from customers. It refers to marketing, logistics, manufacturing, finance and human resources management. All of them should create networks of value creation and may require a deep change (Denning 2015). Special focus should be on HR recruiting practices, building necessary skills and competences, fair motivation systems and environment enhancing collaboration and ambitions of doing something meaningful.

5. Agile Education for Business Management

Apart from the different academic and practical backgrounds special demands arise for complementary soft competences enabling cooperation of multidisciplinary teams. Acquiring such competences is possible only with the use of agile forms and methods combining creative thinking with the discovery process in any application. There are numerous tools to navigate the discovery process. One of them is Compass (Young 2016), the tool to navigate unfolding opportunities when moving:

- From prescriptive to iterative cycles of learning which makes intentions explicit and fosters partnerships, meaningful and relevant education;
- From content to culture, where learning starts with "why" and real lessons are gained from experience;
- From evaluation to visible feedback and reflection, nurturing the love for lifelong learning, partnering for continuous growth, and ownership;
- From control to trust: valuing the freedom of discovery, diversity increases agency and self-direction;
- From competition to collaboration: revealing the power of social intelligence when sharing individual perspectives which helps solve problems, effectively communicate and better understand.

Agile education in management has already been included into the curricula of renowned universities as well as in a variety of dedicated small organizations. For example: the University of California Berkeley Extension (UCBX) Agile Management Program (AMP) "integrates experiential, team-based learning which emphasizes the use of values and principles to understand, apply, and adapt Agile methods and practices to specific situations" (being-agile-management-curriculum 2017). Among other active organizations in agile education the following ones can be mentioned: Agile classrooms, Agora Roermond, Agile Learning Centers, Eduscrum, Blueprint education, MH Willeke agile learning, and Mike Vizdos scruminschool.ORG. (Agile in education.pdf. 2017).

Agile in higher education is believed to respond to a visible misfit between priorities. Teachers-students relationship is more important than administration and infrastructure, competence and collaboration is highly valued than compliance and competition, employability and marketability tower over the syllabus and marks, and finally the attitude and learning skills are more worthy compared to aptitude and formal degrees.*

6. Social Capital and Trust

Fostering the use of agile methods becomes the key issue in acquiring new competences for employability. Regardless of digital competences, attention should be paid to soft skills related to people—be it a client, employee, co-worker, business partner or manager. They need to embrace intellectual capital, knowledge, capabilities, professional competences, energy, emotions and motivations.

Trust as the prerequisite of cooperation can substitute the control if it is based on positive attitudes and experience. Moreover, trust has always been considered in social sciences as a key issue in explaining human and organizational expectations related to communication, team processes improvement, more effective goal attainments due to new initiatives, overcoming barriers, and better risk management. Trust deficit often results in dysfunctional patterns of behavior and pathologies (ILM 2014).

According to Piotr Sztompka, trust is "an assumption on uncertain future actions of other people" (Sztompka 2016). In his opinion expectation of rationality and competences is the minimum level and the least risky in professional relationships. In a mature market economy and society there are institutions watching the legality of people and organizations' behavior, and institutions enforcing responsibility. They represent the formalized system solutions, while the culture of trust embraces the informal set of accepted standards of behavior and credibility.

* www. towards_agile_education_model_jasmina_nkolic.pdf. (12.08.2017)

Trust is a product of social capital—the capital resulting from investment in building relations with other people and/or organizations. This is a critical factor to integrate networks, speed up spreading innovations and strengthen communities. In a broader context of organizations and society the sources of continuous progress could be attributed to the social capital. Social capital producing trust is critical during joint actions, which are indispensable for innovations, collaboration and shared responsibility for results.

There are many definitions of social capital. As defined by Francis Fukuyama, social capital is a set of informal norms and rules as well as ethical values shared by individuals and social groups that enable them to cooperate effectively (1999, 2002). From the point of view of ownership of capital Robert Putnam's definition is remarkable, as in his opinion it does not belong to anybody. It is a public good representing a set of social norms and civic attitudes, which support common actions and trust for both interpersonal and public institutions.

Social capital represented by such virtues as trust, loyalty, reciprocity, solidarity, respect and justice results in the feeling of safety in view of anticipated reactions of others, openness, creativity and innovativeness. P. Sztompka also defines the trust culture and concludes from international research that societies of high trust usually have a high level of economic welfare, effective democratic governance and satisfaction of citizens (Sztompka 2016). However, it is not rational to trust people with doubtful credibility.

Moreover, shaping the culture of trust and social capital is a difficult multi-step process with numerous crisis situations due to trust fragility and multiple destructive impacts. Nevertheless, anticipated benefits from the trust culture are so attractive that it is worth taking efforts to elevate its level. In business the trust ladder metaphor is used for describing the subsequent stages of progress enabling higher benefits from all shared resources of the engaged parties together with additional values, e.g. loyalty, mutual respect, and appreciation.

The process starts from the position of a simple seller. In case of positive experience the seller may become the accepted supplier, then the preferred supplier. Next levels require the increased responsibility of supplier for the benefits of the buyer. The supplier becomes the solution advisor, strategic partner, and trusted partner. It has an immense impact on the strategic success based on value creation, where above these levels a new one is emerging i.e. the digital platform enabling the large scale benefits if followed by efficient operations (Lesniak-Lebkowska 2017).

The platform innovations go beyond traditional industries, change the rules of competitive game, and erode profits of traditional suppliers. The community with its resources becomes the most valuable assets of platforms. Platforms do not control resources but create architecture and enable flows and interactions between clients and suppliers. The higher the value of the whole business ecosystem, the higher the benefits of individual client. The platform owner controls its intellectual capital (Alstyne et al. 2016). All virtual organizations require people-driven trust and specific tools for its securing (Grudzewski, Hejduk 2007).

Despite the transient nature of competitive advantages caused by a turbulent environment, social capital and trust established on all levels of cooperation provide a stable and safe ground for building value to a broad range of stakeholders. The shortage of social capital may have an adverse impact on individuals and their trust level, organizations and society in all its aspects including lack of solidarity, low contributions, corruption, terrorism, appropriation of benefits, discrimination, high number of divorces, drug consumption, suicides, crime level, and legal suits (Fukuyama 1995).

International organizations such as the UN, IMF, World Bank and OECD, focusing on international development, point out the role of factors facilitating cooperation, such as social capital, trust, institutions, relationships, attitudes and values that govern interactions among people and contribute to economic and social development (Grootaert & van Bestelaer).

Summing up the role of social capital in agile management, it is necessary to turn to economists for defining in economics terminology this type of capital. One of the first and most comprehensive definitions was offered by Nan Lin who defines social capital as "investment in social relations with expected returns in the marketplace" (2002, 19). Lin was also critical of many authors identifying social capital with its "products" such as trust, shared value, and norms. This idea was further developed by Zbigniew Bochniarz and his team (2016) who concluded that social capital is defined as a special type of capital resulting from investments in building relations, institutions and networks that produce collaborative attitudes, shared norms and values, mutual understanding and trust. These are critical factors for cooperation with other types of capital and thus contribute to sustainable development. (op. cit.) The next part of this article presents an application of such defined social capital in action research on aerospace clusters in Poland and the USA.

7. Cluster Development as a Case for Successful Regional and Cadre Development – Research Evidence

Based on the assumption that social capital and trust facilitate development of industrial clusters, as well as improve their performance and increase positive impact on regional economies, a comparative research project "Effective Cluster—the Base for Innovation and Sustainable Regional Development" was conducted in aerospace clusters in the Podkarpackie Region of Poland and in Washington State in the U.S. in 2013-2015. The project was led by Barbara Sienko-Kulakowska (Rzeszow School of Business, Poland) and Zbigniew Bochniarz (Evans School of Public Affairs, University of Washington, Seattle, USA) with other scholars from American, Dutch, Polish and Swedish universities.

Their research showed how the growth and accumulation of social capital positively impacts cluster performance, producing synergetic effects (i.e. positive externalities) resulting from better cooperation and trust among major actors within the cluster. In

order to examine this theory, measurements of social capital—its monetization—were proposed and verified through the 2013-2015 period proving the progress in sustainability of the regional economies and their prosperity in both clusters. Although the Aviation Valley in Poland hosts such global manufacturers as Airbus, Boeing, GE, Goodrich, Sikorsky, Whitney & Pratt and is regarded as the regional flagship it is still not reaching the necessary level of synergy to realize its full potential. The Washington State Aerospace Cluster—the world largest commercial aerospace cluster dominated by The Boeing Company—despite its 100 years tradition, still has opportunities and reserves to optimize its potential. Climbing up from the level of functional cluster through clumps and weakly integrated cluster to the high level of its integration will require further investment in social capital to improve internal communication, management, and innovation (Bochniarz, Andreoli, 2008). Both clusters are not yet operating at optimal levels as expected by their major stakeholders.

Nevertheless, their research confirmed that intensive investments in education—in both human and social capital—of present and future cadres starting from the primary schools, secondary and higher education will help build the culture of trust, envision future prospects for individual careers and decent living for the local and regional population.

8. Conclusions

1. Economic progress alone cannot guarantee the state of social welfare and its sustainability, increased social capital and trust also help towards its achievement.
2. When social capital is well anchored in a society, it creates a culture of trust, which strengthens positive incentives for the emergence or reinforcement of individual trust, which in turn could be invested in diverse institutions and development ventures, including business enterprises thus allowing its further multiplication.
3. Social capital and its product—trust—significantly reduce transaction costs and risk, even under uncertainty.
4. Responsible risk management in a turbulent environment requires new set of competences. These competences should guarantee creativity in designing new products, services, processes and solutions. An approach based on empathy, imagination and knowledge can fuel whole new streams of innovations.
5. To be prepared for streamlining innovations for the future, and for a new type of relationships, actions and educational activities are needed, which fit into the concept of Agile. They should be initiated and facilitated in educational institutions, business and social institutions at an adequate level.
6. Regional clusters, networks and partnerships as collaborative structures are more likely to enhance economic and social progress due to trust culture, communication and integrative efforts. Experiential learning allows for the development of cadres capable of entrepreneurial problem solving on a relevant scale. However, the results are still strongly dependent on the macro environmental impacts: political, legal, economic, social, technological, and environmental.

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Sustainable Business as the Base for Sustainable Entrepreneurs: Some Theoretical and Practical Reflections

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Abstract

Threats to the sustainability of the Earth's ecosystem are increasing. It is urgent that we prepare a cadre of entrepreneurs who, with an understanding of the complexity of sustainability, should lead organizations toward a sustainable future. The emergence of entrepreneurs in the sustainability field is critical not only for the business sector but equally important for the public and non-profit sectors. This paper focuses on business entrepreneurs utilizing both theoretical models and practical cases from research conducted by international teams of graduate students on selected international corporations. It starts with a brief overview of the evolution of sustainability, sustainable business and entrepreneurial concepts. Then the author moves on to an analysis of common and specific features of several cases of entrepreneurs who worked to make their companies sustainable. Finally, the paper analyses the effectiveness of delivery methods based on student-centered concepts implemented by creating a learning community with action research.

1. Introduction

There are many reasons to turn to entrepreneurs for solving complex sustainability issues. Following Albert Einstein's thoughts, we cannot solve current problems with old approaches shaped by the past system that produced them. For that reason we need to create an innovative entrepreneurial approach based on human imagination and creativity—on Human Capital (HC). HC is the only creative form of capital. Since human creativity is unlimited, this is the most critical factor contributing to sustainability in general and to sustainable economic development in particular. For economists, effective and efficient resource allocation (different forms of capital) forms the basis for survival in the market and thus for sustainability. Limited resources and growing threats to sustainability require a new form of entrepreneurship that will meet basic human needs *and* reduce environmental threats by offering innovative and sustainable allocation of available resources.

Although the term "entrepreneurship" originally came from business, these days we see more social entrepreneurs. For this reason, it is important to define a universal term of **entrepreneur as an agent who takes the risk and responsibility for managing resources to deliver services beneficial to its stakeholders**. Currently most resources are allocated in the private (business) sector, e.g., according to M. Porter's (2013) research on the US economy, the private sector controlled $23TR (measured by revenues), the government (public) sector controlled only about $3TR (expenditures), and the civic (NGO) sector's share was about $1.3 TR (outputs) in 2013.* Although this allocation may differ in each country, it seems to accurately reflect the global economy. Based on this assumption, I argue that the most critical challenge is to use private sector resources in the most sustainable way for the sake of the planet. I believe that converting business as usual (BAU) into sustainable business (SB) is a primary way to build sustainability. There are two major ways to do this: using **external forces**—governmental regulations (command and control), market-based incentives, and civic pressure (mainly via non-governmental organizations—NGOs), or by **internal forces** that bring the necessary change from within companies. Arguments for the approach based on internal forces come from the megatrend of the growing significance of multinational corporations (MNC) on the global market, which are difficult to influence by specific national policies. So far the external multinational or global institutions protecting the Earth's sustainability are rather weak and not sufficiently effective. For that reason we need to complement them with internal forces that are sensitive to the peer pressure of other competing MNCs. Notably, during the last 16 years the number of companies that have signed the UN Global Compact increased from 100 in 2001 to 350 in 2011 (*UN Global Compact-Accenture CEO Study* 2010), and to 9,000 in 170 countries in October 2017 (www.unglobalcompact.org 2017).

The literature is full of descriptions of different policies influencing business behavior, their effectiveness and costs. Significantly fewer publications are devoted to the role of civic sector, but still one can find many examples of successful actions. However, both approaches have one major disadvantage: They create an adversarial relation with business due to their external nature. In the last 10-15 years, many successful initiatives have established public-private partnerships (PPP) to resolve serious environmental or social problems, but they are still external forces that are not always well-received by business. For that reason, there is urgent need to explore the second approach by applying **internal forces.** This approach will not only remove the above mentioned disadvantage of the first approach, but it will create a significant advantage in the form of pride and ownership in the transformation to SB. In order to make it, we need to educate entrepreneurs—by investing in human capital (HC)—to lead their businesses toward sustainability. The above cited Accenture Study of CEO (2010) indicated that 90 percent of them believed that sustainability was important to company profits and 72 percent said that investing in education was critical for them to succeed in making their business sustainable (ibid.).

* Calculations by Prof. M.E. Porter; Corporate revenue was estimated based on the 9.1% percent net profit margin for U.S. private companies. Source: Bureau of Economic Analysis, 2013, Sageworks Private Company Indicator.

There are many ways of investing in HC. Educational institutions can play a crucial role in shaping new HC, particularly in higher education. Although many successful entrepreneurs—Gates, Jobs or Zuckerberg—are college dropouts, there is a bulk of literature showing that a solid higher education contributed to successful business or professional careers (e.g., Michelacci, 2015; Zumeta et al., 2012). Among academic institutions, business schools play a special role in educating entrepreneurs. For that reason, it is interesting how they treat sustainability courses in their curricula. Current research by A. Hoffman (2017) indicates the tremendous dynamics of business school courses incorporating sustainability into their MBA programs—**a four times increase** from 2001 to 2011. In addition, school participation in teaching sustainability in all types of business education has increased from 34 to 79 percent (Hoffman 2017, 280-281). The author presents two models of teaching business sustainability: The first is "Business Sustainability 1.0: Enterprise Integration" based on adapting sustainability principles into preexisting company conditions in order to remain competitive in the market, and the second is "Business Sustainability 2.0: Market Transformation" focused on systemic enterprise transformation including its role in society (ibid. 279-286). To more easily understand the differences between these two models he characterized them after J. Ehrenfeld (2008), as "reducing *un*sustainability" with the first model, and "creating sustainability" with the second model (ibid.). From the perspective of external and internal forces, the first model would mean an adjustment (from non-compliance to compliance stage) to the external factors and the second, an internal transformation toward sustainability.

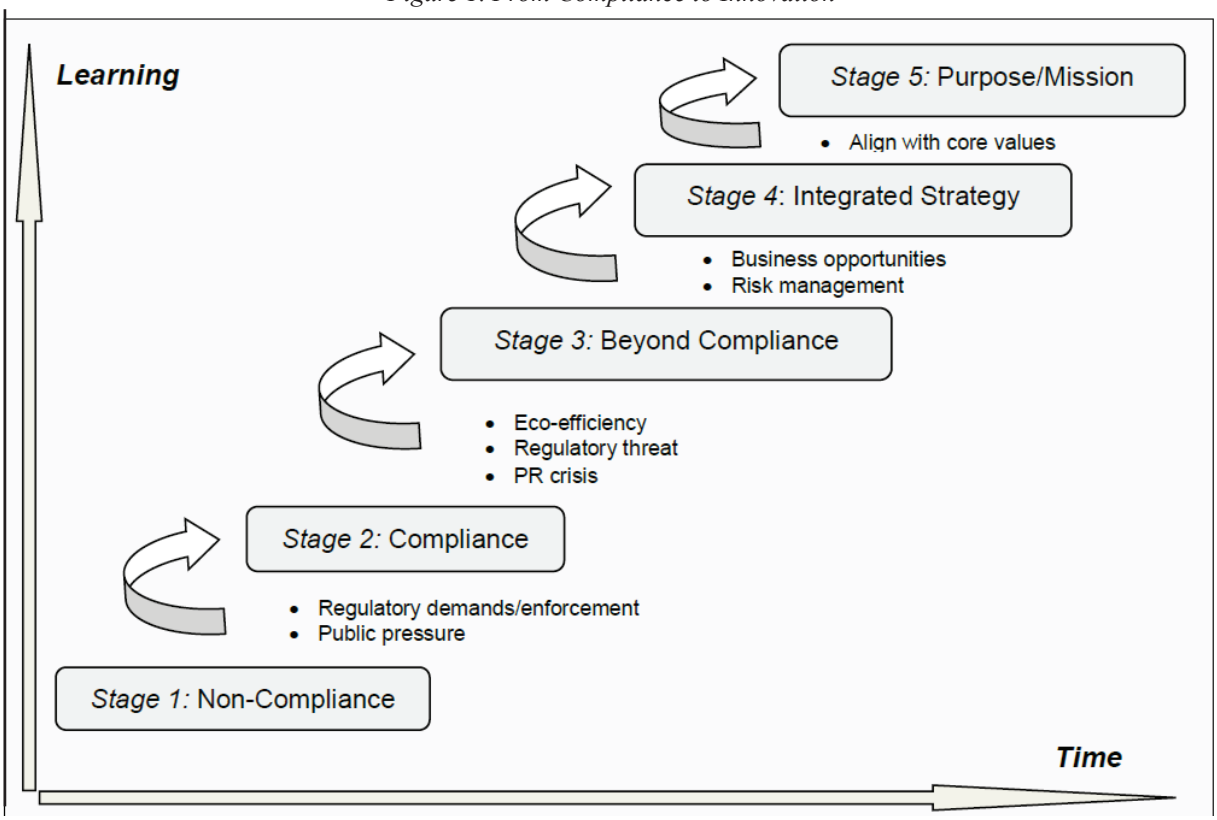
From the business school point of view, they face the dilemma of which curriculum they should teach: business integration or market transformation. Logically, they should start with business integration to stop unsustainable practices, reduce or neutralize external pressure and negative externalities and then move on to design a transformation in the companies considering sustainability. If we look at the implementation process of company integration, we could treat it as a learning process to adjust to the external pressure coming from four different types of "drivers" according to A. Hoffman (ibid. 281):

- *Coercive drivers* – domestic and international regulations and courts
- *Resource drivers* – suppliers, buyers, investors and financial institutions
- *Market drivers* – consumers, trade associations, competitors and consultants
- *Social drivers* – environmental NGOs, media, religious and academic institutions.

2. Defining Sustainable Business

In management literature, this learning process is described as the three phases of the sustainability continuum (*Rejection, Non-Responsiveness, Compliance/Risk Reduction*) by Dunphy and Benveniste (2000) or by the two initial stages *(Non-Compliance* and *Compliance*) by Willard (2005) and Senge (2008), who regarded the whole process as developing a learning organization. **Figure 1** illustrates the process of company development from an unsustainable stage to a sustainable stage (Willard, 2005).

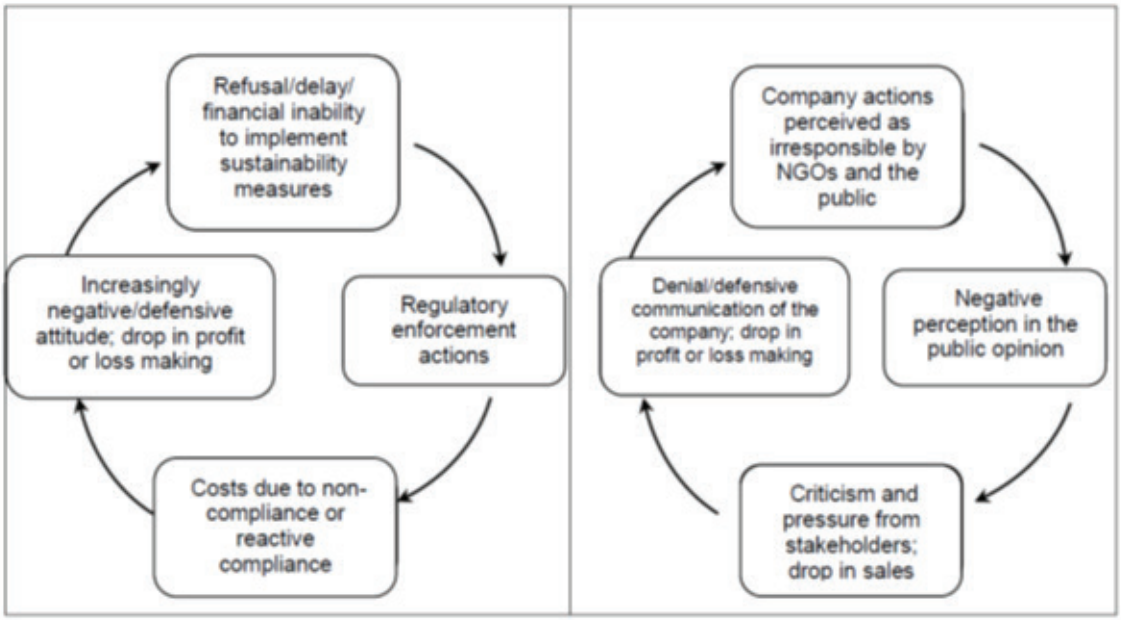
Figure 1. From Compliance to Innovation



Source: Willard (2005), Senge et al. (2008)

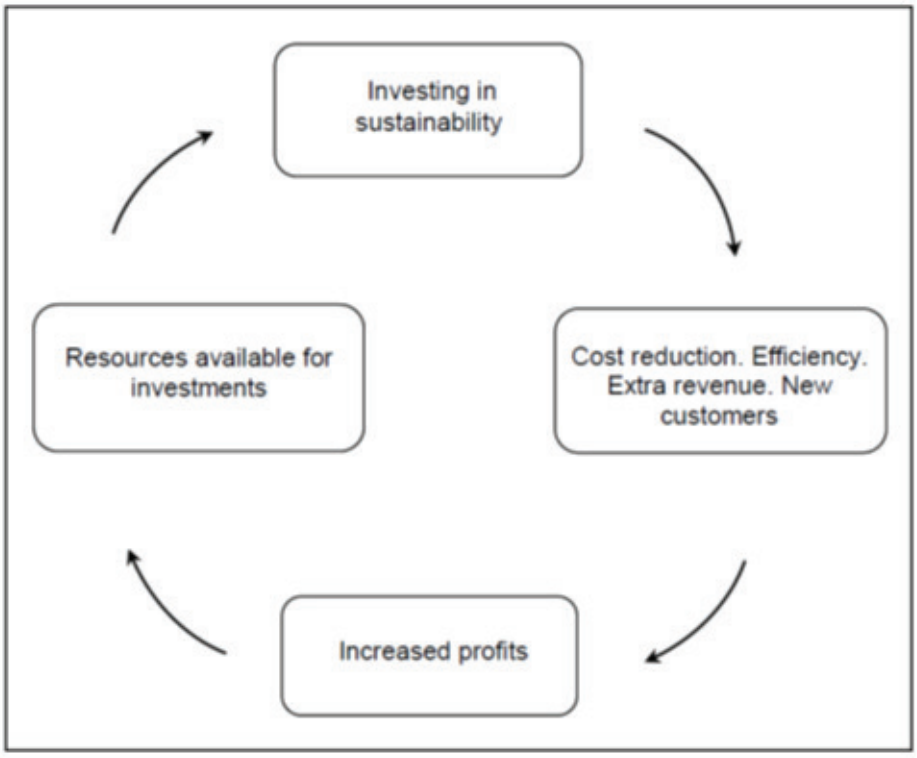
Summarizing the first stages of enterprise development from existing literature, Oncica and Candea (2016) indicated that this is a reactive change made under external pressure and is usually coupled with very expensive direct and opportunity costs. They note a proactive approach would allow companies to link changes with the benefits of their entrepreneurship and innovations. Many companies get stuck in the first two stages in a Vicious Cycle described by them (see Figure 2). The authors—Oncica & Candea—using the tools from System Analysis **illustrate reinforcing loops** that are vicious from the point of moving toward sustainability because they represent the factors opposing or at least delaying the process of implementing sustainability policy measures (ibid. 17). From that point of view the most critical stage is the transition from stage 2 to stage 3: *Beyond Compliance* (Figure 1). Here is a chance to gather momentum and move forward with the implementation of sustainable policy measures by observing when emerging impacts of the transformation—efficiency gains, declining costs and growing reputation—balance or exceed initial investments (Senge et al. 2008). Oncica & Candea illustrate this process by reinforcing loops in the Virtuous Cycle that supports the drive toward sustainability—Figure 3.

Figure 2. The Vicious Cycle – stalling at stages 1 or 2



Source: Oncica & Candea (2016, 17) after Senge et al. (2008) and Willard (2005)

Figure 3. Virtuous Cycle supporting the drive toward sustainability



Source: Oncica & Candea 2016, 18

The central point of this paper is that at this stage of enterprise development, the **entrepreneurship phenomenon** is emerging to meet challenges by entering new territories—going Beyond Compliance to start building sustainable business. The most popular meaning of entrepreneurship is "the activity of setting up a business or businesses, taking on financial risks in the hope of profit" (Oxford Living Dictionaries 2016). The most critical characteristic of **entrepreneurs** is taking a risk for future gains, which might also lead to failure with losses of capital or even bankruptcy. Entrepreneurs, contrary to managers or other employees, take the risk of losing not only their incomes but their property and career. There is a limited pool of people with natural entrepreneurial abilities who are also responsible risk-takers. The business education process can further expand the pool by producing HC equipped in entrepreneurial knowledge and skills to facilitate the process of moving firms to stage 3.

Although it is challenging to move to stage 3, the authors—Oncica & Candea—underline that moving from stage 3 to stage 4 (*Integrated Strategy*) marks "a real qualitative leap: it requires the ability to link market opportunities with corporate responsibilities" (ibid.18). This is a challenging stage demanding "creative destruction" leaps by innovative discontinuity of existing industrial processes and product design enriched by sustainability values (Willard 2005, 29). "Moving from stage 3 to stage 4 requires internalizing sustainability notions in profound ways, both personally and organizationally. […] Sustainability-based thinking, perspectives and behavior are integrated into everyday operating procedures and the culture of organization" (ibid.). According to Willard (2005), companies in stage 4 and stage 5: *Mission/Purpose* look similar but differ with their motivation. "Stage 4 companies 'do the right things' *so that* they are successful businesses. Stage 5 companies are successful businesses *so that* they can continue to 'do the right things'" (ibid.). Moving from stage 3 through stage 4 and 5 requires not only Schumpeterian "creative destructors"—entrepreneurs—but also **visionary leaders** who are able to articulate an ambitious vision for the firm, and also mobilize employees to follow its new mission toward reaching **new values and establishing a new corporate culture** embracing sustainability. This deep business transformation is a complex, risky and time consuming process. Education can facilitate the expansion of currently limited HC with the leadership knowledge, skills and attitudes to embrace sustainability.

Stage 3 in the Willard model indicates the beginning of the sustainability transformation process described by Hoffman as "market transformation" of the company. For Hoffman, in writing about Sustainability 2.0, the most important factor is focusing on transforming business education that needs a systemic approach, bringing radical changes to curricula and delivery methods based on **the new conceptions** of the following components (Hoffman 2016, 283-7):

- Market parameters – e.g., "malleability and multiple forms of capitalism"
- System parameters – holistic, systemic approach with company as a part of the system
- Operational parameters – e.g., optimizing supply chain logistics
- Organizational parameters – hybrid and networked organizations
- Business metrics and models – "from regenerative capitalism and collaborative consumption to conflict-free sourcing and environmental finance"
- Redefinition of the role of companies in society – redirecting business to play a positive role in resolving serious challenges facing society.

Responding to the growing demand for sustainability courses from executives and students (particularly after the 2008 financial crisis), the Association to Advance Collegiate Schools of Business (AACSB) created new standards for social and environmental sustainability (based on Sustainability 1.0) that accredited schools were required to implement by the school year 2016-2017 (ibid. 287). Hoffman regards this as the first step in institutionalizing sustainability teaching, which will have to follow with the Sustainability 2.0 courses that are real market transformation drivers. He also believes that the market (comprising resources of business, government and civic organizations) is "the most powerful organizing institution on Earth and corporations are the most powerful organizations within it" due to their abilities to innovate, produce and distribute. For that reason he concludes that "if there is no solution coming from the market, there will be no solution" (ibid.).

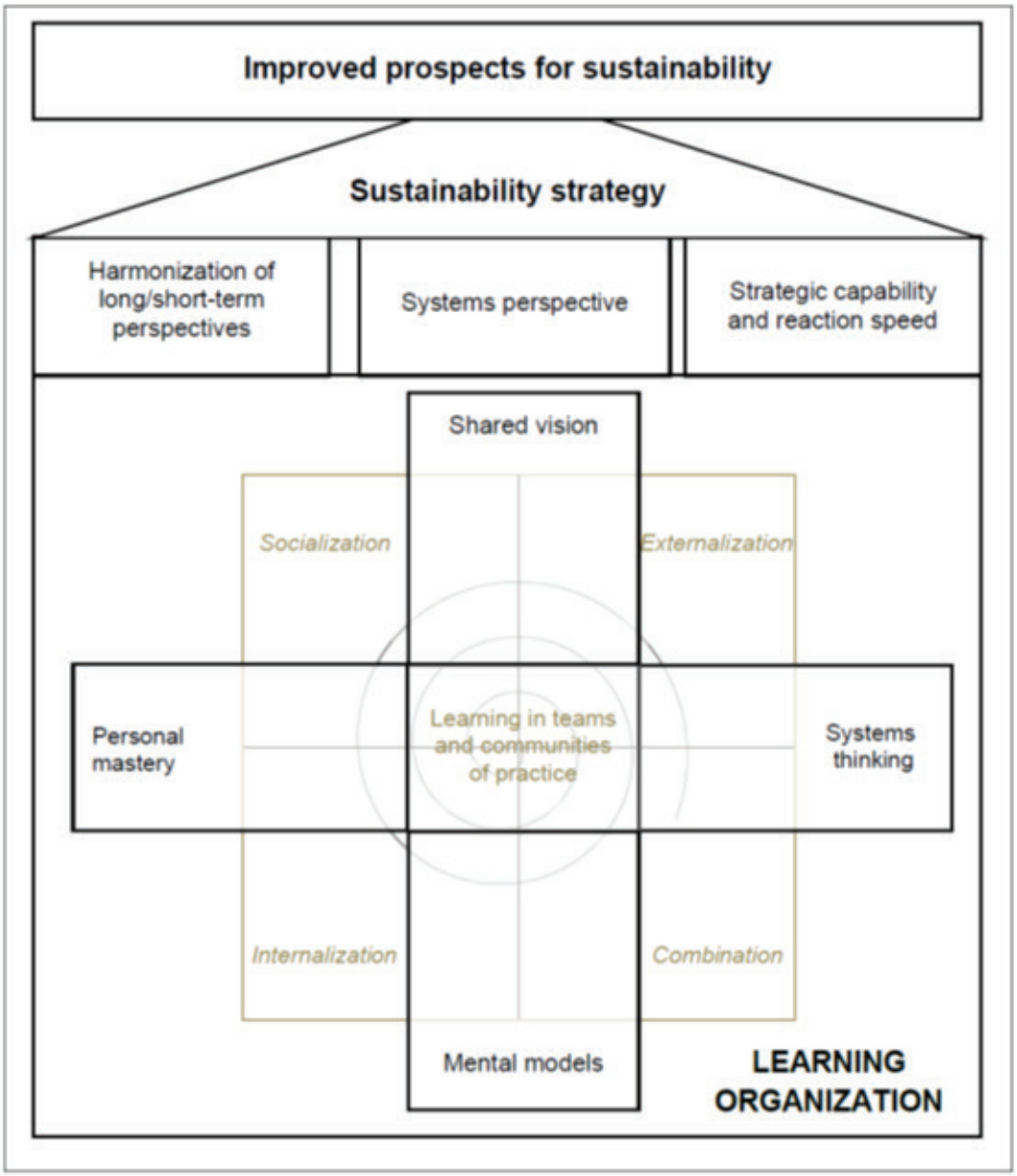
Now that I have explained the process of transforming companies to adapt sustainability and how to organize teaching, one may ask what a **sustainable business** (SB) is and how it contributes to sustainable development. No doubt that the 2008 financial crises and the Great Recession following it brought the issue of sustainable business (SB) to the forefront for many constituencies, but with many different understandings of the term (Oncica & Candea 2009). For some SB means **survival** of the market (Werbach 2009), for Porter & Kramer (2011) it means **staying competitive by creating shared values** (CSV), for others (Wilson 2003; Candea & Oncica 2008; Rok 2014) SB is a complex and evolving term based on five pillars: 1) Sustainable development, 2) Environmental management, 3) Stakeholder theory, 4) Corporate social responsibility, and 5) Corporate accountability.

In the recent synthesizing study on SB, Oncica & Candea defined sustainable business as

> *a business that is prosperous in the long run, which makes it able to provide its shareholders, for an indefinitely long time, with a fair return on the invested capital. In order to approach this ideal, the company should strive to develop a strategy that integrates business objectives with consideration for the needs of a wide range of stakeholders, selected on relevance criteria. This way, the strategy of a sustainable business will eventually include objectives that concern all three pillars of sustainable development: economic, social and environmental (ibid. 98).*

The authors treat business sustainability *as a continuous process of transformation, of learning, of organizational becoming* (ibid.). Based on their studies, they developed "*a model that consists of five stages in the evolution of integrating sustainability in the strategy and values of an organization*" and *reveals the progressive stages in which contemporary enterprises may find themselves in terms of their commitment to becoming sustainable* (ibid).

Figure 4. The role of the learning organization in the development of a sustainable business strategy



Source: Oncica & Candea (2016, 120)

Quite a comprehensive presentation of the Oncica & Candea model of SB influenced by the leading thinkers in management sciences, particularly by Senge's concept of learning organization, this model is motivated by the fact that it was selected as the leading model applied in graduate student action research within the course of "Building Sustainable Business" at the Kozminski University in Warsaw, Poland, in spring 2017. The authors—Oncica & Candea—applied the concept of learning organization to strategic management to reconcile short- and long-term shareholders' interests. In addition they incorporated the idea of the knowledge spiral from Nonaka and Takeuchi (1995) in their model illustrated in **Figure 4**. Oncica & Candea show two interrelated levels—level "0" combining the learning cycles based on the "*knowledge spiral*" and cycles taking place in team and community practice introduced by Senge (2006). They explain that the "*cycles underline the other elements of the model situated at level '1,' i.e. four disciplines of the learning organization and the strategy development*" (ibid.120). Finally, the authors conclude that the learning process at the "0" level creates the base for developing SB.

In summarizing this methodological section, it is important to note that sustainable business is not a substitute for sustainable development or the Earth's sustainability, but without businesses that are involved in moving toward sustainability in a strategic way, we cannot sustain our life on this planet.

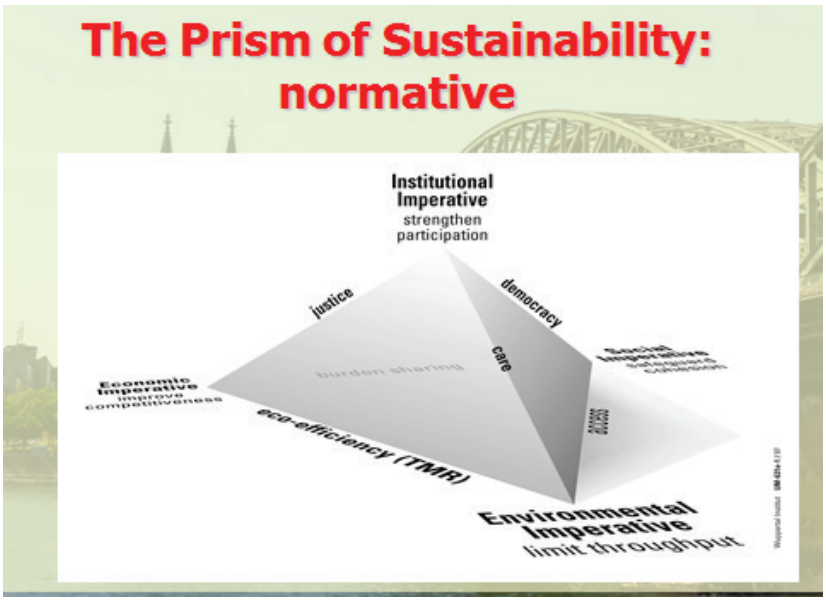
3. Sustainable Development, Sustainability Science And Institutions For Sustainability

The term "sustainable development" came from the report *Our Common Future: Report of the World Commission on Environment and Development* (1987) authored by Norwegian Prime Minister G. H. Brundtland and prepared for the United Nations' Conference on Environment and Development (UNCED), held in Rio de Janeiro, in 1992. The report came up with the most popular definition of the term over the last 30 years: "*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (ibid. 43). Despite its popularity, it was not easy to operationalize it and implement it in practice at different levels of human activities. One of the most popular ways was implementing the principle of the triple-bottom-line (TBL)—economy-environment-society—to evaluate the sustainability of business or public actions. It was not precise but at least led to the consideration of three major dimensions of any activities. To make it more precise, economists developed two basic approaches to measure sustainability: one based on human material wealth maximization (MWM), usually measured by the Gross Domestic Product (GDP) per capita, and the second based on maintaining non-declining total capital (NDTC). So far, the first approach has been the most popular, but its deficiencies have been obvious since it was introduced by S. Kuznets (1937), and its critics are growing year by year (e.g., quite recently by Stiglitz et al. 2008). Knowing these GDP deficiencies, American economists R. Solow (1972) and J. Hartwick (1977) suggested that there is another way of sustaining human wealth—by maintaining non-declining total capital under certain conditions. One of the strong supporters of NDTC was the British economist D. Pearce, who proposed a transitional sustainability indicator from MWM to NDTC in the form of genuine savings (GDS) or slightly modified as adjusted net savings (ANS) in 1994. He has also convinced the World Bank to include ANS in its Statistical Yearbook since 1999. The ANS, contrary to GDP, includes changes in human (HC) and natural capital (NC) in the form of investments in HC and decreases in NC by extraction of minerals, energy resources and damage caused by climate change (depletion rents)*.

The significance of the introduction of ANS was the inclusion of two additional forms to man-made capital (Km)—HC and NC. Although this is still an indicator based on gross national income (GNI), which came out of GDP, it was a big step forward in the way of thinking about sustainability.

Thirty years later, after the publication of the Brundtland Report, we are much better equipped to measure sustainability. Since 2001 we have a new discipline—Sustainability Sciences, which is an interdisciplinary, holistic science offering many interesting approaches to assess and measure sustainability (Kates *et al* 2001; Spangenberg 2011). Spangenberg (2005) asserts deficiencies in operationalizing sustainability using the TBL approach and suggests a substitution by **quadruple bottom line** (QBL). He gives convincing evidence that the **fourth dimension** of SD should be an **institutional dimension—securing democracy, justice and care**—**Figure 5**. It is noteworthy to add that well-designed institutions—mainly **norms and rules**—influence the transformation of people's attitudes and habits (an important feature of HC) toward those desired by society, and this way **are becoming values**—**building blocks of a new culture**. For that reason **sustaining an institutional base is critical for sustainability** in general at any level of human activity, from communities and firms to national and world-wide levels. Institutions as social inventions are results of human relations, and interactions contribute to the wealth of nations (Bellah et al., 1992; Bolan & Bochniarz 1994). The more time people spend on building relations, the more they invest in their social capital (SC), which in turn produces better norms and rules, trust and values such as mutual respect, loyalty, tolerance and common goods (Bochniarz 2008, 2016). This way the **strength of institutions depends on the value of SC invested.**

Figure 5. Four Dimensions of Sustainability

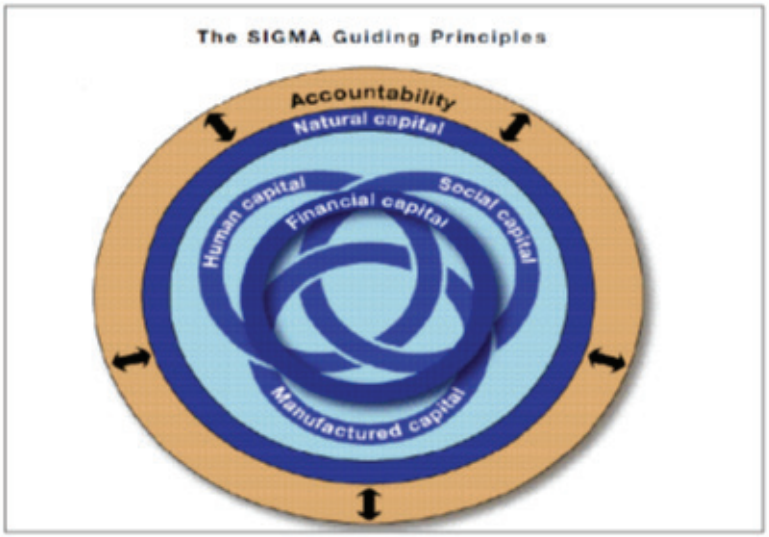


Source: Joachim H. Spangenberg Sustainable Europe Research Institute SERI Germany (2016)

* GDS indicator (Pearce 1994):GDS = GDP – C - Kmd D + EdI - EngD – MinD – ForD – CDD
Where: GDS-genuine domestic savings; GDP-gross domestic product; C-annual consumption; KmdD- man-made capital depreciation; Ed I- education expenditure (investment in HC); EngD -energy resource depletion (depreciation of NC); MinD -mineral resource depletion (depreciation of NC); ForD - forest depletion (depreciation of NC); CDD - damage to the environment due to carbon dioxide emission (depreciation of NC).

During the last 20 years the popularity of SC has increased tremendously in social sciences publications. From the economic point of view, its place and relations with other forms of capital were often not clear. Recently, economists (Goodwin 2003) and representatives of management and other sciences from the Sigma Project (2003) proposed a convincing model studying the relationship between SC and traditional forms of capital—HC, NC, manufactured capital (MC), and financial capital (FC)—Figure 6. They show the growing significance of SC, particularly in advanced economies. One can observe this phenomenon in many levels of human activities—from local to national and even international or in business, government or civic sectors.

Figure 6. Five Types of Capital



Source: The SIGMA Project (2003)

In the recent years after the financial crisis of 2007-2008 and the following recession, we observed a huge wave of populism often combined with nationalism, or even fascism, worldwide, threatening democratic institutions, culture of fairness and care, and creating serious challenges to sustainability. Introducing the QBL is critical these days at every level of human activity and in each sector. This is a significant step far better than TBL in assessing sustainability.

In a series of articles, an international research team led by Archibald & Bochniarz (2003, 2005, 2008 & 2009) argued that at least 10 Central and East European countries (CEEC-10) made significant progress—based on the TBL—in their transformation from totalitarian political systems with centrally planned economies to democracies based on market principles since the beginning of the 1990s, and particularly after joining the European Union in 2003 (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia & Slovenia) and in 2007 (Bulgaria and Romania). The team concluded that those CEE-10 completed their systemic transformation and started moving on a sustainable path of development (Archibald *et al*. 2009). However, recent developments since 2010 indicate that after many successful years, some of them (Hungary since 2010, Poland since 2015, and probably the Czech Republic since the fall 2017 election) are being taken over by the populist-nationalistic wave with significant changes in their basic institutions, including their constitutions (in legal or illegal ways) and basic rules of law. In Poland for instance, the ruling coalition led by the Law and Justice Party (PiS) started to dismantle the independence of the Constitutional Court by replacing—mainly illegally—its independent judges by their own loyalists just after the parliamentary election in Fall 2015. By 2017 they succeeded in completely subordinating the Court to the executive branch of government despite numerous actions of parliamentary opposition parties, country-wide protests and interventions from the European Commission and the International Venice Commission comprised of prominent European and American judges. Today nobody can challenge the Polish Government of the constitutionality of its activities, including passing new laws, regulations and many other decisions.

Last July the government used the superfast track of the legislative process, passing three basic laws that de facto changed the Polish constitutional order—the Common Court System, the Country Justice Council (KRS) and the Supreme Court—by simple majority rules in the Sejm (Parliament) and Senate, bringing fundamental changes to the country's political system in just two weeks. Both the process and the contents of laws violated the Polish Constitution and the basic parliamentary procedures in many areas, among others by excluding opposition parties from discussion and nongovernmental organizations from consultations. Although the President, who is also from PiS, initially vetoed two of those laws (those two significantly limited his power in favor of the General Prosecutor), the Common Court System law was signed by him and went into effect on September 1st. Two other laws after negotiations between the President and the PiS chairman J. Kaczynski—the real policymaker—went again through the parliamentary amendment process, were passed by the ruling majority and signed with several insignificant changes, shifting some power from the General Prosecutor to the President and Parliament on December 20, 2017.

Since September 1st 2017, over 130 heads and their deputies of regional courts have been fired without any comments or justification and new judges have been appointed, who are loyal to the General Prosecutor, who is also the Minister of Justice. The justice system is losing its independence, as it is subordinated to the executive branch run by one party interest. Basic values like

rule-of-law are disappearing step-by-step, the nation is deeply divided, scared and insecure, including private business, who cut their investments to the lowest point in a decade (this is a significant threat to sustaining manufactured capital—MC). Economic growth is mainly fueled by consumption expenditures financed from budget transfers (mainly by the "500+" program for about 3.5 M people with multiple children), which was instrumental in granting the PiS election victory in 2015.

In addition, the recently introduced government "education reform" is trying to recreate the structure of the Polish K-12 system in the 1980s (8+4) with old traditional ways of teaching based on teacher-centered approaches. Critical and integrative thinking was replaced by extended national historical curricula and religion classes at each level, creating the potential for long-lasting damage to the country's human capital (HC). Natural capital (NC) is also victimized by the current government which introduced massive "sanitary" cutting in Europe's oldest ancient forest "Puszcza Bialowieska" protected for conservation by Polish and EU laws, and despite massive protests from academia and NGO communities, EC & UNESCO, the trend had been continuing until the government was changed for another PiS based but more technocratic at the beginning of January 2018. Finally the aggressive xenophobic propaganda exercised by the government controlled media against opposition parties, intellectual elites, refugees, neighbors and the European Union (EU) destroys the social capital (SC) that slowly grew after the transformation. This path of development cannot be sustainable until the changes introduced by PiS are reversed. So far, the larger part of the nation—but without sufficient representation in Parliament—is not giving up but when they will win, nobody knows at this point.

This brief case study shows that Poland, which experienced the fastest economic growth among CEE-10 from 1992-2015 and often was exemplified by international organizations as the leader of the transforming economies in CEE, could easily damage its image and destroy its basic civic culture based on democracy, freedom, openness, mutual respect and tolerance for diversity by ideologically motivated institutional changes. This example underscores how important the **fourth dimension of sustainability** is and the need to operationalize it by the QBL, not only at the national level, but also at the regional, local, community and enterprise levels.

4. Lessons from Selected Cases

4.1. Assumptions, Organization and its Implementation

The lessons presented below come from the recently held graduate course on "Building Sustainable Business" at the Kozminski University (KU) in Warsaw, Poland. The main goal of the course was providing the knowledge and skills necessary to sustain business in the face of global competition and create positive impact at the level of a firm, region or country. The design of the course was student-centered and the role of the instructor was as a facilitator of building the learning community. All participants were treated as equal partners, who contributed to the community based on their knowledge, experiences and skills. The course was based mainly on cases with an introductory theoretical element from the recently published book by Oncica & Candea (op. cit.)—selected chapters—and two chapters from the instructor's publications.

There were 11 cases discussed in the class, 7 of them based on students' field research projects elaborated by 3-5 person teams. The quality of the project was equally important as the active class participation. From 38 initially enrolled students, 28 completed and passed the minimum requirements of the course. It was a very international cohort with only 9 students from Poland, and 17 from other European countries (including 13 from Ukraine), 8 from Asia and 4 from N. America. The students had to build and exercise their soft skills and competencies—including entrepreneurship and leadership—by selecting areas of their projects, designing their own team "constitutions" to effectively manage the project, conduct interviews with stakeholders, distribute team work according to their best capacities and prepare policy recommendations. Two of the stakeholders (from different projects) participated in final presentations and one of them delivered a guest lecture. The instructor conducted two anonymous team member performance evaluation (one in the mid-semester, one after project completion) and provided written guidelines for the contents of the project and for effective team presentations. At the end of the course an anonymous instructor performance and course evaluation was conducted with an average score of 4.4 points out of 5 maximum points.

4.2. Identifying Sustainable Entrepreneurship in Selected Cases:

4.2.1.The Nike Case

The Nike case was elaborated by Oncica & Candea (op. cit.) and was treated as a role-model for the students' projects. This is a perfect case to teach sustainable entrepreneurship because it is the story of two business partners—Phil Knight and Bill Bowerman, who with an initial $500 in capital established the company in 1964, which became within just a few decades the leading global corporation in the industry (ibid). The case covers over 20 years from 1992 until 2012, showing how the company was struggling to climb the 5 stages of the sustainable business ladder (Figure 1. Willard and Senge, op. cit.). In order to better understand the company milestones to sustainable business (SB), the authors divided two decades into three periods with specific names: 1992-1998 "Social Challenges," 1998-2005 "Business Integration" and 2005-2012 "Positive Vision" (ibid. 175). Probably under the influence of the 2nd Earth Summit in 1992 and significant involvement of big corporate involvement, Phil Knight, then chairman and CEO, established "The Nike Environmental Action Team" (NEAT) to monitor environmental compliance. The same year, they formed a three-person team to deal with the program called "Reuse-a-Shoe" and started collaboration with Paul Hawken—an American guru of environmental sustainability to educate the NEAT team. These decisions show the company leaders were **open to new ideas**, a characteristic of successful entrepreneurs. They also took concrete steps to learn about environmental threats and implement policies to reduce or eliminate them. One of the results of the "community learning process" was adaptation of The Natural Steps (TNS), one of the most popular worldwide frameworks institutionalizing company sustainability principles and culture in 1998 (ibid. 176).

Although the company was progressing fast by managing environmental issues, **social issues became a big challenge**. As a typical apparel and footwear company, Nike relied heavily on outsourcing manufacturing in developing countries without any control or interest in work and safety conditions. As one of the most recognizable brands in the industry with high financial performance, Nike was on the radar of global NGOs and media who brought to light their serious violations of labor standards since the early 1990s until 2002. The initial reaction of the leadership was defensive, presenting the company as a design and marketing corporation and not responsible for the working condition of their production suppliers. Particularly painful for them was Michael Moore's documentary film "The Big One" in 1997 showing not only poor working conditions but also exploitation of child labor. Phil Knight in his angry reaction told Moore to report Nike to the United Nations (ibid.).

From the theoretical point of view presented earlier, this was a typical behavior of a company facing difficulties in breaking the Vicious Cycle (**Figure 2**). This arrogant response was probably a turning point in Nike's defensive policy, when their own managers raised the issue as to why such an excellent company cannot take a proactive approach and effectively resolve such social problems in their supply chain (ibid. 177). Internal pressure started emerging to move out of the Vicious Cycle to the Virtue Cycle (**Figure 3**) and to the 2nd stage—*Compliance*—of building business sustainability (**Figure 1**). A few years later (2011), the Vice President of Sustainable Business and Innovation—Hannah Jones—stated that sharp critiques were "an early wake-up call to what become a greater wave of change… a massive revolution in the business community" (ibid.). So the boycotts and protests worldwide forced the leaders to change the course, who later on took corporate responsibility for social problems in 1998. Again Phil Knight announced in the prestigious National Press Club that Nike will make radical changes in treating their suppliers, imposing a series of reforms including the introduction of the Code of Conduct and a revised bonus system with respect to environmental and social values (ibid.) Nike took the risk of institutionalizing radically **new values** within the supply chain. This decision could produce not only positive but also negative effects, including cost increases due to internal monitoring and external auditing of implementation process, the possibility of production interruption due to elimination of some supplier who could not meet the requirements of the Code.

The next organizational activity was establishing the Corporate Responsibility Committee of the Board of Directors led by the Board member Jill Ker Conway in 2001. This was another step in **institutionalizing environmental and social values**, e.g., environmental stewardship and occupational health, at the highest level of company management (ibid.). The Committee also received the authority to oversee the publication of the first full-fledged CSR Report in 2001 adding additional **important values—openness and transparency**. These initial steps undertaken since 1998 indicate that Nike moved to building a **new corporate culture** aligned with the idea of **sustainability**. This way their CSR moved from tactical in the earlier stages to **strategic** after 2001, according to Porter & Kramer (2008). In the Willard-Senge ladder, the company moved to the 3rd stage—*Beyond Compliance* (**Figure 1**).

It is worthwhile to note that such risky and costly but fully **entrepreneurial decision was unique** in the footwear and apparel industries. Nike's VP Hanna Jones was aware that those were costs of being an earlier leader in the industry, which could, however, stimulate company R&D and innovation (ibid. 179). One could say that it was a **risky but effective investment in the sustainable future of Nike**. In order to sustain the gains of this transformation, the company leaders took several steps to strengthen their business model, particularly in social areas by becoming founding members of the Fair Labor Association (FLA) and establishing the Global Alliance for Workers and Communities Foundation in partnership with the International Youth Foundation, MacArthur Foundation and the World Bank (ibid. 180). The first one—FLA—was an NGO organized in 1999 by human rights activists with companies, trade unions and other organizations focused on creating "lasting solutions to abusive labor practice by offering tools and resources to companies, delivering training to factory workers and management, conduction due diligence through independent assessments, and advocating for greater accountability and transparency from companies,… and others involved in the global supply chains" (FLA 1999– ibid.). The second—the joint foundation—concentrated on improving workers' living conditions in emerging economies. Their particular interest was working and living conditions for young women who were composed of 80% of their suppliers' employees. In order to address their needs, Nike financed a global survey of 67,000 female workers in their factories worldwide in their native languages and neutral locations. The Survey follow-up report and actions were made available to the public, particularly to other companies to follow Nike in improving working conditions (ibid.).

In addition to these two organizational efforts focused on social problems, the company leaders had established their own—the Nike Foundations—to support adolescent girls in poor regions worldwide to overcome **poverty** and **gender discrimination** in 2004 (ibid.). This way, according to Nike's CEO, the company wanted to support the two UN Sustainable Development Goals (SDG) and become an "engaged corporate citizen" utilizing the Foundation's investment to initiate "a positive cycle of development, complementing, complementing the company efforts to improve its fundamental business practice" (ibid. 180-181). Taking into account these big social initiatives, one can conclude that Nike's leadership moved further beyond strategic CSR to the stage of creating shared value (CSV), according to Porter and Kramer (2011). In the Willard-Senge ladder, the company moved to the 4th stage—Integrated *Strategy* (**Figure 1**). In order to complete the integration, Nike needed to bring together not only its top leaders but the whole staff – including managers and front line employees—to learn the new sustainable corporate culture. This was a complex process associated with high risks of failure. It required both visionary leadership and wise entrepreneurship, and a lot of patience.

It is interesting that Nike started building a long-term vision based mainly on environmental sustainability in 1995. The leadership role was taken by the Advanced Research and Development Division for Footwear department led by Darcy Winslow. They were responsible for identifying and analyzing new ideas, materials and technologies, which could bring disruptive innovations and create new development opportunities for Nike for the next 15-20 years (ibid. 182). In 1998 Winslow ordered a toxicity study by

MBDC to check the manufacturing material for the shoes. The study was eye opening for her and served as an encouragement to present their conclusions to the top corporate management to get support for her recommendations. The main conclusion delivered to Nike leaders was that "if Nike wants to genuinely support sustainability, the thrust should be in finding solutions to eliminate waste and toxics from company products right from product conception" (ibid. 182). Her recommendation was well-received by the top management and soon Winslow was appointed (1999) to lead the newly established global division of Sustainable Business Strategies. The division defined three major environmental goals for 2020, such as Zero Waste, Zero Toxics and Closed Loop, which provided the vision for the company for the next 20 years and were included in their 1st CSR Report (CRR Nike, 2001, 17). The major ways to implement this vision and thus build corporate responsibility was education, awareness and other actions through the organization. It is very important to know that Winslow introduced her original approach to make this radical change. Instead **of generating the change** through management directives, she preferred to make it **through people's voluntary involvement in the project** (ibid. 183). So she started multiple one-on-one meetings with the key managers and designers, convincing them over time, followed by two-day meetings with 200 key designers, managers and leaders of sustainability **to discover that people at Nike are innovative and innovation is the company's core value.**

In order to facilitate absorption of the vision within company the "Team Shambhala" internal program was launched in 1999 designed and delivered by SoL-Sustainability Consortium consultants. The goal of the program was "to get the entire company—20,000 people world-wide —grounded in a way of thinking that naturally took environmental and social issues into account in every decision the company made and every action they took" (ibid. 183-184). Almost over a year, 100 persons—the most influential formal and informal leaders—among whom 65 were called "captains" (leaders from all over the world and areas of company), 35 "champions" (directors, general managers and vice presidents) went through the program "to develop their abilities to think systematically about environmental issues, accelerate their self-learning and empower them to make real-time decision in pursuit of business goals" (ibid. 184). Note that the SoL-Sustainability Consortium is an association of business leaders declared to be a "learning community" committed to more sustainable practice and strongly influenced by Peter Senge, the founder of Society of Organizational Learning (SoL) at MIT in 1997 (ibid.).

In 2010, Winslow, in summarizing the Shambhala program, underlined that it helped transform "Nike's approach to sustainability, created 100 internal champions who launched dozens of landmark projects that continue to deliver against our 2020 goals" (ibid. 195). The program also produced 11 Maxims that express Nike spirit and guide staff activities. In this summary, she also expressed appreciation for the contributions of the Sustainability Consortium, and particularly to Senge and Elkington for helping Nike to understand the notion of sustainability from a strategic perspective, which took them some time (ibid.).

Summarizing this period one could see significant investment in HC because of education and training, consulting and advising combined with investment in SC by spending a lot of time on building lasting relations, producing trust, mutual respect and new culture based on sustainability and innovation integrated across the company. Hannah Jones, sustainability leader and VP of Sustainable Business and Innovation, stated in her talk in 2011 that engaging with stakeholders in dialogue, listening and looking back at themselves and taking responsibilities led to "massive transformation" of corporate culture resulting in understanding their full footprint, both environmental or social. This way, she added, they learned the value of working in partnership with civil organizations and others, and that "you start looking internally, changing the business processes and business systems. And I call that the Business integration phase" (ibid. 187). Based on her statement, one can assume that Nike significantly advanced the 4th—*Business Integrations* stage (**Figure 1**). Their 2005 CSR report was a landmark for the whole industry because Nike published the full list of their suppliers with their locations in the hope that other companies will follow them and through such unprecedented transparency would improve the outsourcing system. This is an act of visionary and ethical leadership, as well as entrepreneurial investment in social capital: better relations in the industry.

In 2006 Nike announced corporate reorganization to accomplish better customer service and enable better inner workings (ibid. 187). The new structure followed six categories of activities: running, men's training, basketball, soccer, women's fitness and sports. By 2009 Nike completed restructuring with the main goal of better "aligning its core competences with forthcoming opportunities" (ibid. 187). The restructuring led to a radical change in the CSR function to support the company's growth strategy and facilitate transformation to a sustainable business model (ibid.). It also received a new name—Sustainable Business & Innovation (SB&I)—with a new mission to "design the future" rather than "retrofit the past", according to its new head Hannah Jones of SB&I division and VP of Nike (ibid.). She further explained that throwing away the concept of "Corporate Responsibility" and introducing "SB&I" means that "we needed to move out of being police and move into being the architects and designers of the future growth strategy" (ibid. 188).

The new business model required a comprehensive program to get employees involved to envision Nike's sustainable future and the role they would play. The managers went through scenario planning workshops assisted by The Natural Steps using a special tool called "the funnel" to bring the company to "a place where growth is decoupled from the scared natural resources and has far more equity built into the fabric of how wealth is disposed" (ibid. 189). This means that the company invested a lot of their resources in building SC—interpersonal relations within the company and also with their material and equipment suppliers (through the Code of Conduct and internal standards) to integrate all of them with Nike's new business model and the "vision of a greater good" (ibid.). The integration process along the new business model was facilitated by several projects (e.g., the Nike Considered Design project to design fully closed-loop products since 2005 or the GreenXchange platform to invite organizations for collaborating in the creation of intellectual property, processes and ideas responding to sustainability-related challenges since 2010) and tools such as the Considered Index and Sourcing and Manufacturing Sustainability Index to push the company and its suppliers to be… "lean,

green, empowered and equitable" (ibid. 190). Since 2011, all Nike designed shoes and approximately 98% of all newly launched products are "*considered*" to have the features envisioned before. (ibid.192).

These two basic numerical facts—in addition to the above mentioned implemented policies and projects—clearly confirmed that sustainability innovations spread throughout the whole company and became their competitive advantage and core corporate value. Nike reached the 4th *Business Integrations* stage and started moving toward the 5th *Mission/Purpose* stage (**Figure 1**). At this level of development Nike leaders realized that the term "sustainability" may no longer be an appealing vision for their employees. For that reason they substituted it (probably influenced by P. Senge) with the concept of a "*Better World*" as a more inspiring vision (ibid. 204-205). This new inspiring concept the company leaders started to operationalize with many efforts to "*create shared vision*" with their employees and then complemented with long-term contracts for fewer but more committed employees with the joint "*vision of a greater good*" contractors (ibid. 205). It is worth mentioning that reaching this level of development took Nike over 20 years.

4.2.2. The Siemens Case

This case is based on international students' action research project conducted by a team of four persons from three different countries within the framework of the course "Building Sustainable Business."* The company was chosen by students due to its ranking in *Forbes* magazine as the most sustainable global corporation in 2007, and in 2012 Siemens was awarded Best in class—*Industrial goods and services* by Dow Jones Sustainability Indices—and included in the Global 500 Carbon Disclosure Leadership Index for the fifth time in a row (students' report: *Assessing Sustainability of Siemens* –ASoS_2017, 54). The official name—SIEMENS AG—is a global technology engineering conglomerate integrating industries such as electro-technology, energy, medical care (particularly diagnostics), infrastructure and others. In 2017 Siemens and its subsidiaries employed approximately 372,000 people worldwide and reported global revenue of around €83 billion. It is Europe's largest industrial manufacturing company. From sustainability interests, this is one of the world's largest producers of energy-efficient and resource-saving technologies (ibid.)

The students' assignment was to analyze and evaluate policy recommendations of the last 10 years of company performance—2005-2016—from the point of the process of building sustainable business. For that reason, they did not take into account Siemens' shameful past, such as using slave laborers from the Nazis' death camps (including Auschwitz) during WWII or the huge bribery scandal from 2001-2005, which radically shook the company worldwide, and for the first time in its 170 years of existence forced them to hire an American CEO to transform the company management structure and a former German financial minister to monitor the transformation.

Overcoming their past and escaping from this ethical crisis was a great challenge for the new company leadership. For that reason, the company listed on top of its corporate responsibilities for 2005 such goals as:

- **Corporate governance**: commitment to financial transparency, open and honest communication with shareholders, compliance with the financial reporting requirements, and a two-tier control
- **Sustainability**: compliance with environmental legislations and with own environmental regulations.
- **Corporate citizenship**: addressing social problems by training of young people, and promoting arts and culture.
- **Business practices**: enforcing binding rules and guidelines to ensure ethical dealings with business partners (ibid. 48-49).

It is worth noticing that Siemens declared through these goals its commitment to invest seriously in human capital (HC), social capital (SC) and in creating shared values (CSV) for their communities—pillars of sustainable business. In addition, in 2005 the company started implementing three-year *Fit4more* program to strengthen its sustainable path combined with innovation leadership in the industry. An excellent example of sustainable entrepreneurship was converting restrictions into business opportunities by utilizing EU emission trading system (ETS) of greenhouse gases (GHG) in developing new technologies, increasing fossil fuel efficiency in car engines and reducing pollutions (ibid.). From the point of view of Willard's sustainability stages, Siemens moved from the *Non-compliance* 1st stage to *Compliance* 2nd stage (**Figure 1**).

The next year, 2006, marked another milestone for Siemens which then introduced the new intermediate-term program *Fit4 2010* to boost company growth and strengthen its corporate responsibility by meeting the following goals:

- Revising the Code of Conduct within their supply chain
- Introducing a new environmental management system (EMS)
- Reducing work accidents and occupational diseases until 2012 by implementing new Occupational Health & Safety standards
- Introducing the Corporate Responsibility Award and developing a Disaster Relief program for catastrophe prevention to achieve corporate citizenship goal
- Speeding up corporate responsibility reporting to improve monitoring of meeting performance goals (ibid.49-50).

It is worth mentioning that implementing EMS objectives initially scheduled for the year 2007 (with the objective of 85% implementation worldwide) was achieved in 2006 with the higher score of 88%. This helped the company to monitor the data of

* The international team included: G. Ablikimova, K. Hrynyk, B.Y. Kwon & B. Prokopchuk.

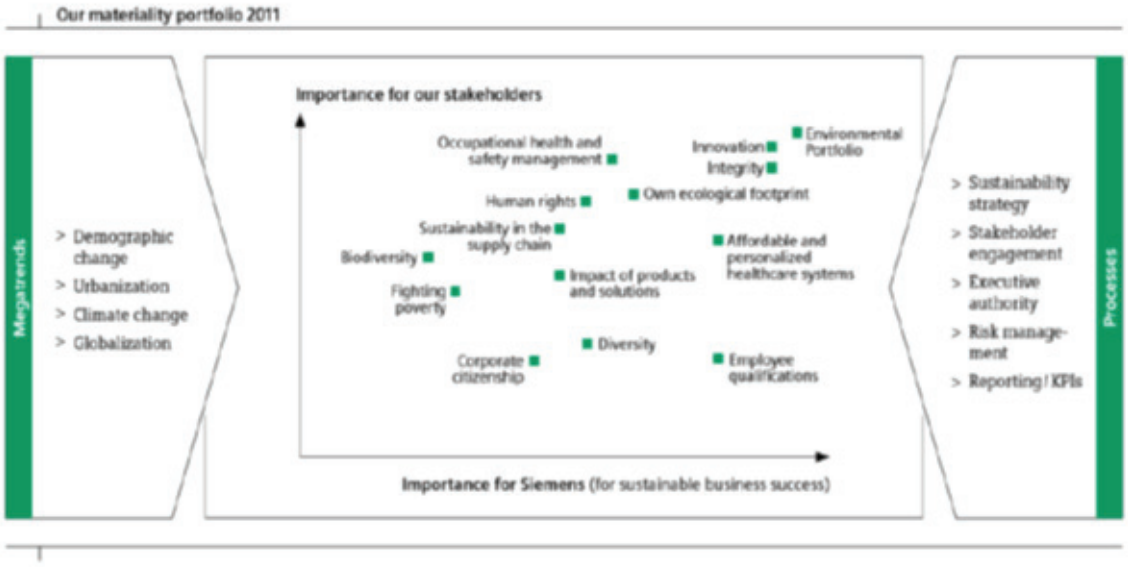
their performance more carefully. Taking into account the above mentioned data, students assessed that Siemens started moving to the 3rd *–Beyond Compliance* stage (**Figure 1)**.

In 2010 Siemens made a big step toward company integration with the new program called *One Siemens* to boost **sustainable value creation** and **company growth** based on the three directions strategy:

1. Leveraging the power of Siemens,
2. Focusing on innovation-driven growth markets,
3. Getting closer to customers (ibid. 51).

Figure 7 shows an ambitious environmental "materiality portfolio" that was to be achieved by the end of 2011 by Siemens and their stakeholders. It was a good managerial tool showing interconnections between the company and its stakeholders' values and goals, as well as the associated challenges and risks. Some numerical data includes reducing by 300M tons GHG emissions by 2011—20% of the 2006 level—and increasing revenues from the environmental portfolio to at least 40B EUR by 2014. The intermediate reports indicate that the company was performing very well, reducing GHG by 332M tons by 2012 and increasing revenues from environmental portfolio to 33.2B EUR—two years before the deadline (ibid. 53). The successful implementation of the *One Siemens* program indicates that the company moved to the 4th *Integrated Strategy* stage of sustainable development (**Figure 1**), strengthening not only internal structures but also relationships with their stakeholders on the supply and demand sides.

Figure 7. Siemens' Materiality Portfolio 2011



Source: (Siemens Sustainability report, 2010, p58)

In the move toward a more advanced stage of sustainability, Siemens has launched a very ambitious *CO_2 neutral Siemens* program to reduce their global carbon footprint by 50% in 2020 and **become a carbon neutral company by 2030** by:

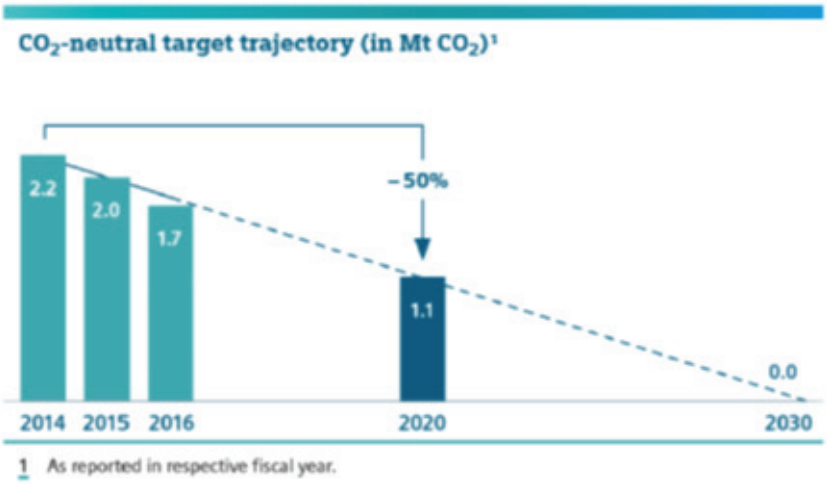
- Optimizing fleet of 45,000 vehicles leading to reduction of CO_2 emissions
- Buying clean power
- Investing 100M EUR in company energy efficiency improvements over the next three years
- Boosting the use of decentralized energy systems - e.g. wind, solar, energy savings and others (ibid. 55).

Successful implementation of this program, as illustrated in Figure 8, mobilized the company to initiate another program called the *Business to Society* (B2S) program to meet the 17 Sustainable Development Goals (SDG) by following these four steps:

1. Adopting the most relevant development priorities.
2. Measuring and identifying contribution.
3. Drawing strategic actions that enhance contribution.
4. Transparency (ibid.56 - after the *Siemens Sustainability Report, 2016*, 7).

The last two programs—*CO_2 neutral Siemens* and *Business to Society*—indicate that the company redefined its mission to serve as a good role model of environmental stewardship and of global citizenship with a commitment to facilitate implementation of the 17 SDGs. From the point of the Willard/Senge five stages of sustainability development (op. cit.), it means that capitalizing on previous contributions and with the launching of these two programs, Siemens started moving to the highest—the 5th *Purpose/ Mission* stage of development (**Figure 1**).

Figure 8. Implementing the Carbon neutral Siemens program



Source: (Siemens Sustainability Information, 2016, p9)

In summarizing Siemens' path to sustainable company, my students emphasized the role of both **external and internal sustainability drivers**. The first mobilized the company's creative and entrepreneurial HC to convert EU-level and national regulations and policies into innovations giving them competitive advantage with new technologies and processes. The second group of drivers, well-expressed in Siemens' mission—We make real what matters—contributed to the integration of the company and its values, better self-awareness of their employees and strengthening of the brand value (ASoS 2017, 59-60). The students were also impressed with the company's commitment to promote not only financial and environmental, but also social values. One of them—ownership culture—initiated 170 years ago by its founder Werner von Siemens was continued by his family until a few decades. This ownership culture meant cultivating long-term interests in company development, counting each employee's contribution to the company's success, and developing a feeling that each of them has an ownership stake in the firm expressed in commitment to excellence, innovation and responsibility (ibid.60). It is worthwhile to underline that the ownership culture proclaimed and practiced over decades had to be modified to respond to new challenges and to correct company failures particularly in ethical areas during WWII and at the beginning of XXI century after bribery scandals. For that reason the value of responsibility was further strengthened by transparency, honest communication with stakeholders, new code of conduct for the suppliers, closer contacts with customers and global citizenship. These factors indicate that the company had to respond to external and internal challenges becoming in the process a double-loop learning organization, which facilitated its path to sustainability—students stated.

4.2.3. The Carrefour Case*

The Carrefour Case (TCC) was prepared by a team of three graduate students from three different countries in EU. They decided to focus on the retailer operations of Carrefour, one of the most important segments of operations of the Carrefour Group. Initially the firm sold food products and other household items. Launched in 1959 first in France, they have since moved abroad and operate now in over 30 countries in their fully owned stores and through franchises with 380,000 employees in 12,000 stories bringing almost €104B from over 13M customers (TCC 2017, 3). The student team decided to choose Carrefour because it quickly became the number one retailer in Europe and the number two in the world just after Walmart. They were interested in how this market leader implemented principles of sustainable business (SB) and sustainable development (SD) in its strategic vision and mission, as well as, in daily practice (ibid.). The students first analyzed the development of the whole company based on company reports and then its operations in Poland and CEE, where they also conducted a series of interviews. This way they collected data to assess the process of building sustainability, including the role of the most critical types of capital—human (HC), social (SC) and the natural (NC)—in the process and finally they elaborated policy recommendations.

The company entered CEE quite late—first Poland (1997), Czech Republic and Slovakia, later Romania (2004)—due to their leadership concern in meeting high EU sustainability standards in those four countries, known in the past as very polluted and rather poor. After several years, Carrefour closed its operations in Czech Republic and Slovakia. The process of building SB at Carrefour Polska is overseen by the Sustainability Department staffed by three people located in the Quality Division in the Polish headquarters who monitor every Carrefour shop in Poland. Recently, they also monitored implementation of another EU program called the *Circular Economy*. The program brings a lot of benefits such as boosting the economic development and competitiveness by saving cost for the industry and making the environment more sustainable in Europe (Europea.eu, 2016 after TCC, 18). The Carrefour Polska is responsible for implementing all aspects of SD, with particular attention to sustainability of HC, SC and

* The international three-person team from three EU countries: C. Szwedo, N. Ramy and M. Turunen.

NC. One of the examples of such efforts is popularizing its *corporate culture* of openness by giving opportunity to employees to speak their mind, to enable them to be creative, and initiate their own projects (ibid. 28). This is a good example for encouraging *sustainable entrepreneurship* and giving every employee an influence on the company's performance, their own self-improvement and professional growth within the company (ibid. 28). In addition, every year, the company participates in nearly 200 social agreements with its partners in France and other countries on problem solving in such areas as employment, equality of gender, disability, professional training (ibid.). For instance, in Poland they signed the Diversity Card to implement equal opportunities and anti-discrimination policies in the workplace. As a result, 800 employees with disabilities are currently working for Carrefour Polska, thanks to collaboration with the non-profit organization "PION I EKON". Moreover, their management teams are composed of around 60% women (ibid.). The company signed the United Nations Women's Empowerment Principles and showed explicitly their commitment through the Women Leaders program (Carrefour's Annual Report, 2015 after ibid. 30). It is worth mentioning that Carrefour offers motivating wages and other social benefits adapted to local conditions to boost collective performances and knowledge sharing among their employees. They also invest heavily in HC by providing a variety of training and workshops—in 2015 over 5.1 million training hours. In 2016 one of their training priorities was using new technologies (ibid. 30 from Carrefour's Annual Reports, 2015 & 2017).

Besides investing in HC, Carrefour paid attention to investing in Social Capital (SC) both within the company and with its suppliers. Commitment to cooperating with its suppliers and sharing knowledge with them in identifying their most beneficial development targets produced a unique competitive advantage over its competitors. (ibid. 31) One of the best examples was increasing support to small and medium-sized enterprises (SMEs) by simplifying local product preferences and introducing financial support schemes. This way the company within several years was able to increase the share of locally produced items (in the case of food up to 74%) and most importantly, creates wealth in the regions of Carrefour operation, and significantly reduces pollution from transportation. Carrefour Quality Lines program has engaged more than 21,000 producers to commit themselves to follow quality and sustainable goals set by them (ibid. 32). These are concrete indicators of enormous effectiveness of investments in SC.

This is also an excellent example of creating shared value (CSV) to customers by focusing on improving the economic stability and progress of suppliers' product quality, as well as ensuring enhanced safety and traceability of core products (ibid. based on Carrefour Annual Report, 2015). The company has also introduced a self-assessment tool that its suppliers can use to compare themselves to other suppliers in terms of sustainability practices and assess if there is a need for corrective actions and improvements. In addition to sustain their suppliers' proactive behavior in designing and sharing sustainability innovations, Carrefour has been giving prizes to best ideas in events such as Supplier's Major Challenge for the Climate Change since 2015. Furthermore, projects such as Inbox in France give suppliers access to Carrefour's employees' expertise and thus, allow suppliers with an insufficient knowledge and resources to build up their businesses according to the high standards of one of the leading retail brands in CEE region (ibid. based on Carrefour Annual Report, 2015). The students evaluated the relationship between Carrefour and its suppliers as a great example for benefits of investments in social capital which produces high level of trust and clear rules and norms for everybody. It also indicates strengthening the integration process within their supply chain, a marked feature of the 4th stage– *Company Integration* (**Figure 1**).

In building SB, the company invested in NC conservation and improvements as the foundation of other forms of capital. This is particularly important for Carrefour because healthy NC is the main base for food products produced and sold by the organization. In this case the company has established four pillars of sustainability policy, two are directly related to protecting the environment (ibid. 35-37):

1. **Combating waste:**

   a. In order to reduce food waste, Carrefour regularly donates food to local food banks. For example, in Poland, Carrefour has invested in fourteen refrigerated vehicles to ensure the preservation of the quality of the food sent to Caritas and other non-profit organizations.

   b. As a part of the circular economy programs the company stored rainwater in some selected stores and reused it to clean floors and car parking areas.

   c. Since 2013, the stores have also started a new project to reuse the bio-methane produced by spoiled fruits, vegetables, and flowers from their stores and started using it as fuel for their trucks. This project is limited to some selected urban areas in France but the company aims to expand it in the future as part of its objective to reduce CO_2 emissions.

   d. Carrefour has pledged to decrease its CO_2 emissions, and as a result of their partnership with the UN Conference on Climate Change that took place in Paris in 2015, the retailer set clear goals for better use of its energy. As described in their website, they aim to reduce CO_2 emissions by 40% by 2025 based on their 2010 levels. Their long-term goal is to reduce emissions by 70% by 2050. So far, in 2015, they have already managed a decrease of CO_2 emissions by almost 30% in terms of the 2010 level (Carrefour.com, 2017).

2. **Protecting biodiversity:**

   a. The agro-ecology, the Quality Line is the largest program that includes the efforts of both Carrefour and its suppliers committing to reducing the use of pesticides, to rotating crops, and to refrain from treating soils chemically (Carrefour.com, 2017). The company is dedicated to selling animal products using animals that were not fed with antibiotics. This concerns fish, chicken,

and eggs in particular. The retailer also implemented beekeeping above some of its stores in France and Poland to help reduce the disappearance of bees (ibid. 34).

b. Carrefour promotes sustainable fishing. This is why they pledged to stop deep-sea fishing since 2007. (Carrefour.com, 2017).

c. Another example of Carrefour's resolution to limit the negative impact of its operations concerns palm oil. They have managed to source 100% of the palm oil used in their brand products from sustainable sources. Indeed, all of the palm oil suppliers were certified by the Roundtable on Sustainable Palm Oil (Carrefour.com, 2017). This fits within the company's overall goal of protecting forests around the world.

d. Carrefour's efforts toward sustainability include also its suppliers. The self-assessment tool, *Autodiagnostic*, is an example of Carrefour's work toward expanding their sustainability standards throughout their entire supply chain (ibid.).

Although the examples of building environmental sustainability indicate that the company is a leader among major retailers in sustainable practice and initiative, thereby making progress in company integration (Stage 4th), the students discovered, however, through interviews and field visits that franchised stores do not have the obligation to meet sustainability standards of Carrefour Group, and every country is not on the same level with actions taken towards sustainability in other branches. For instance, the implementation level is very advanced in France but less advanced in Poland (ibid. 35). Since customers tend to associate these stores to the Carrefour brand, such differences within an organization can have a negative impact on the company's image and reputation. Moreover, it seems that the extent to which independent stores commit to sustainability objectives vary significantly between countries. For instance, whereas the stores in France are continuously following the latest initiatives introduced by the headquarters, branches in Poland are yet to come to terms with such embedded activeness (ibid. 36). Therefore, in order to get to level 5, they would need to rethink their vision and mission in relation to sustainability. For that reason, **the students elaborated two recommendations:**

- First: Carrefour needs to take a **tighter control of the company branches abroad and on franchises** by putting requirements on them to adopt and follow the same sustainability goals as the corporation has stated its organization strategy.
- Second: As the second largest global retailer and a quite successful leader in implementing sustainable practices within its supply chain, Carrefour should take leadership and more responsibility to teach their customers to change their consumer behavior to meet the demands of the growing sustainable society. These initiatives among others could include providing guidance for improved recycling methods as well as helping the consumers to reduce the usage of plastic material including shopping bags and packages. They could also educate their customers about facts regarding environmental impact of certain products, how to reduce their negative ecological imprint and increase social benefits of fair trade. Carrefour could work on convincing their customers that consuming ecological products creates not only additional benefits to them (e.g. healthier diet) but also produces environmental gains for the global community and ecosystem. This way, showing additional values of such products, the company could boost a greater demand among customers and thus increase its business. This "win-win strategy" Carrefour has already implemented with its suppliers. So it would be a natural extension to do this on the consumption side.

5. Conclusions & Recommendations

The author explored existing opportunities—in theory and in practice—to educate a cadre of champions for sustainability or a better world—sustainable entrepreneurs based on the concept of sustainable business (SB), as a learning organization (LO) introduced by Peter Senge (1990) and recently popularized by Dan Oncica and Dan Candea (2016). After analyzing several models of SB and recent development in defining sustainability, including the four dimensional model of Joachim H. Spangenberg (2007, 2008), he moved to three practical cases of global corporations—*Nike, Siemens & Carrefour*—studied in the graduate course on *Building Sustainable Business* (BSB) delivered last year at the Kozminski University in Warsaw, Poland. The author came to the following conclusions:

1. The concept of SB as a learning organization is a good foundation for educating about sustainable entrepreneurship (SE) and/or entrepreneurs.
2. The experience based on delivery of the BSB proved that the fourth dimension of sustainability—**Institutional**, linked with values (culture) such as **democracy, justice** and **care**—is very important at every level of human activities—from a business firm or any community organization level to regional, national and global levels. For that reason, it makes sense to move from the triple-bottom-line (TBL) symbol of sustainability to the quadruple-bottom-line (QBL).
3. Careful analysis of the selected cases confirmed that **education**—formal, informal and self-education—is a **powerful force** for shaping new leaders and entrepreneurs for SB within a framework of **the learning organization** (LO) concept.
4. The action research projects selected by students proved that there is a good chance for change toward SB, even in large global corporations by utilizing both **external and internal forces** influencing their behavior and strategic decisions.
5. The **internal forces**—the main focus of this paper, could become effective tools in building human (HC) and social capital (SC), and conserving natural capital (NC) for sustainable development (SD) or—using a more updated term—a **better world.**
6. The case studies show that an unlimited creativity of business entrepreneurs (HC) could offer much greater variety of internal policy tools (incentives, projects, programs, codes of ethics, standards, etc.) than external (regulatory) policies toward SD. This

way, turning **sustainable entrepreneurship** for **creating shared values** and **win-win** solutions for all participants/shareholders helped companies moving within the *Virtue Cycle* and avoiding traps of *Vicious Cycles* created often by external forces.

7. The selected cases confirmed that the **largest resource allocation in the business sector** (compared with public or civic sectors – Porter 2013) could be utilized toward sustainability or a better world if there is **visionary leadership** combined with **SE**, **systemic approach** and **long-term strategy**. This is not an easy and simple process, but it is possible to succeed.
8. The BSB course with its **community learning design** might be regarded as an effective approach in shaping new SE based on the enterprise as an LO and team work.
9. The **student-centered approach** of the BSB delivery boosted **critical thinking** and the application of creativity tools taken from the LO concept in practical cases.
10. Finally, sharing the action research results with their stakeholders at the end of the course contributed to **building students' responsibility** for solid work during the semester and gave them the opportunity to share the fruits of their project successes.

Based on the above mentioned conclusions, the author proposes the following recommendations for building sustainable businesses:

1. The academic community, particularly associated with World Academy of Art and Science (WAAS) and World University Consortium (WUC), should popularize the quadruple-bottom-line (QBL) approach to sustainability and sustainable business and/or organization (SB) and this way replace the traditional TBL approach.
2. WAAS should further discuss the roles of non-material capital—intangible assets—particularly HC and SC, and improve the measurements of their values compared with other forms of capital in its New Economic Theory (NET) program.

Both organizations—WAAS and WUC—should popularize courses such as BSB that contribute to strengthening internal forces of change toward SD within companies.

Teaching BSB courses in advanced economies has a significant role to influence future corporate leaders—particularly MNC—thinking about global sustainability—*better world*—which have their HQs located in the part of the world. However, this teaching is vital in developing and emerging economies, where they badly need sustainable entrepreneurs to move their citizens out of poverty. These economies meet their basic needs and push on sustainable path of development based on innovations and are focused on avoiding mistakes committed before by advanced economies.

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