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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 These critiques all imply that 'modern' education has now become 'outdated' (Milojevic, 2005).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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