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A SYSTEM STRATEGY FOR HIGHER EDUCATION

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The exponential growth of technology and artificial intelligence means that the world is rapidly changing. Education is not exempt from this trend. New ways of engaging and teaching are needed. This need has been exacerbated by the arrival of COVID-19, which is stimulating higher education to reevaluate its approach to teaching and learning. This is a conceptual paper that looks at several theories and philosophies that underpin all forms of "learning" especially those theories coming from the systems paradigm which the authors consider is essential for future higher educators. Based on these theories, a new approach to higher education is proposed and an example given of how it could work in practice. The article provides a platform for further discussion and debate to support the strategic vision and direction of travel for higher education.

THIS CONCEPTUAL ARTICLE is a discussion document on new ways of disseminating information at university level that is based on the work of three experienced practitioners in the field of higher education. It integrates current understanding of how the human brain works, what sort of knowledge will be need in the 21st century, and how this can be combined with technological developments to provide an education in a more digitally enabled society. It also draws on the well-documented differences between teaching mature (andragogy) and younger learners (pedagogy). Mature learners are normally more self-directed, independent and can draw on previous learning experiences. This allows any curriculum designed for their needs to be more student centered, application based, and focus on problem-solving (Savicevic, 1999). The term "andragogy" is a discipline that deals with the education and learning of adults in all its forms of expression (Henschke, 2003; Reischmann, 2003; Savicevic, 1999). New teaching methods will necessitate new evaluation techniques which, it is suggested, may involve much more self-criticism and reflection. The hypothesis proposed is that higher education will need to consider new teaching and evaluation methods to better fulfill a meaningful future role in society. The methodology adopted to examine this hypothesis is to use the participant–observation experience of the authors who have spent their working lives in universities and supplement it with secondary data in the form of extensive research in the literature, publications, and online information. This paper concludes with suggestions of a new approach to teaching and evaluation in higher education institutions.

BACKGROUND

The standard ways of disseminating knowledge (such as books and lectures by experts to a group of learners) have been in existence for hundreds of years. Advances in technology and the different attitudes of today's society mean that new dissemination methods are now both possible and needed. Although the future cannot be predicted with certainty, the lockdown due to COVID-19 has led to a greater increase in the use of certain digital tools within the education sector. These include webinars, podcasts, online collaborative tools such as Microsoft Teams and Zoom, open education provision such as massively open online courses (MOOCs), and mLearning (learning via mobile devices) (Marengo et al., 2017, 2018). These tools

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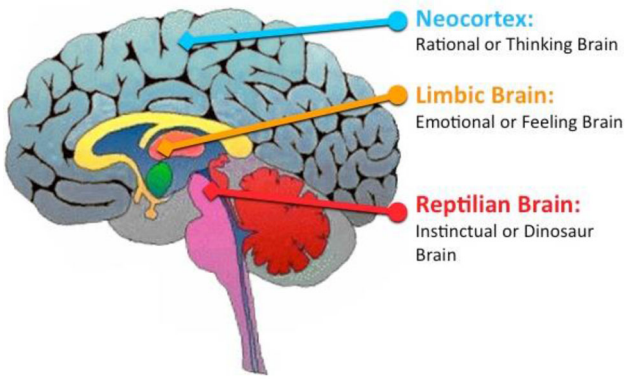

FIGURE 1. ILLUSTRATION OF THE TRIUNE BRAIN (SOURCE: GOOGLE)

are useful but are not sufficient. They need to be integrated together to provide a new dimension of collaborative and social models of learning. The article suggests that the solution is not simply to improve and increase online learning but to incorporate it into different methods of delivery which fully utilize the advances in modern technology and neuroscience research. The avenues that this article explores are concept formation, cybernetics, system thinking, and learning epistemologies.

CONCEPT FORMATION

Over the last 20 years, there has been a complete revision of how the brain functions—in particular in how it forms concepts. The classical theory was based on various assumptions and was known as the triune brain (Figure 1). Some assumptions for the triune brain were that there are universal "fingerprints" for feelings that are common to all humans and specific parts of the brain are centers for specific feelings. The brain was also seen as an action–reaction machine, and by changing reality (environment) one can change the reactions, i.e., feelings. Sagan (1986) popularized this version in his best seller on the development of human intelligence (Dragons of Eden), and Goleman (1995) used it in his book on emotional intelligence. The theory was backed by well-documented psychological experiments and was regarded as rational, intuitively sound, and satisfying good common sense (Butler, 2009).

However, when the previous experiments were repeated, many were found to be flawed, and this model of the brain became discredited. There has thus been a movement away from the reactive brain (classical) to a constructivist one (Barrett, 2017). All areas of the brain work together as a whole, i.e., as a system. Some major discoveries are:

- Both beliefs and emotions are constructed by the brain by what is termed the "interoceptive network." This network has input from the senses AND the body, and each input requires energy.
- The sole purpose of the brain is to keep the energy budget of the brain in balance. The brain is working continuously and is bombarded with incessant, noisy, and ambiguous energies, and has to make sense of them. It does so by making educated guesses of what will happen next (predictions) which are based on past experiences and feelings.
- The brain continually compares these predictions with inputs and makes a correction, if needed. The interoceptive network also takes energy into consideration and then initiates an action. This whole process takes milliseconds and is unnoticed by the person who believes the action is a reaction to a stimulus. It is not. It is a reaction to what the brain perceives to be reality. Thus, reality is only what the person believes it to be.
- These mechanisms have evolved over the millennia and cannot be changed. The consequence is that to change behavior, one has to work on the material that the mechanism accesses—past experiences. Current events become the past, and so people must build up a set of pleasurable events that were effective (and therefore can reinforce belief).

It is now also believed that emotions play a large role in the learning process (Dimasio, 2005). This has implications for education and means that approaches to education should enable the learner to connect to the subconscious levels of their brain.

CYBERNETICS AND SYSTEMS THINKING

The science of cybernetics arose from the conferences sponsored by the Joshua Macey Foundation and ran from 1941 to 1960 (Pias, 2003). Their aim was to pursue meaningful communication across all scientific thinking and thus provide an integrated framework that would unite science. The first conference, which was entitled "Feedback Mechanisms and Circular Causal Systems in Biological and Social Systems," was attended by an unprecedented network of great minds at the time. The word "Cybernetics" is taken from the Greek word "kubernētikós" meaning steersman (Weiner, 1948) and can be called the science of organisation or control. It posits that there exist general laws that govern effective control, and these laws are applicable to all levels and all sizes of organizations. The original cyberneticians realized that to be effective, their new discipline must cover all knowledge. This led them to "Systems Thinking," and

the two subject areas have developed together in similar ways.

The word "system" has several different meanings in English. It can mean "how to"—We have a system for playing Roulette. We have bidding systems in Bridge. This is not the meaning in this article. It can also mean a set of rules and regulations—they are always trying to beat the system. Again, this is not the meaning in this article. A final meaning connects it with computers or machines—We have a systems problem. I am using the word "processing system"; all conferences put in place a feedback system. This latter would be the design, distribution, and analysis of a questionnaire and is not a system as it is meant for this article. For this article, the definition of "system" is taken from Ackoff (1971).

> *"A system is a set of parts where no single part has an independent effect on the whole. The way that a part affects the system depends on what the other parts are doing at that time. Thus, a system is a whole that cannot be divided into independent parts."*

One important aspect of this definition is that the essence of a system comes from the interaction between its parts and not on their individual existence. Another is that there are properties of any system that only belong to the whole and not possessed by any of its parts. One can improve the performance of the parts taken separately, but this will not guarantee that the performance of the whole would necessarily improve. (It could even get worse!) It is the way the parts fit together that determines the performance of a system.

Boulding (1956) suggested different levels of systems that are becoming more complex. The first five covered static frameworks, clockworks, thermostats, life systems, plant, and animal systems. Level six is the human level: "… the individual human considered as a system… In addition to all, or nearly all, of the characteristics of animal systems, humans possess self-consciousness, which is something different from mere awareness." Self-reflexivity is "… bound up with the phenomenon of language and symbolism." Level seven is the level of social organizations. "The unit of such systems is not perhaps the person-the individual human as such – but the 'role' – that part of the person which is concerned with the organization or situation in question." Like any other classification, Boulding can be questioned. It is, however, to be noted that, after nearly 40 years, it has not been basically contradicted by any subsequent experimental or theoretical development. This article deals with levels six and seven.

Several other features that characterize systems are as follows.

Interdisciplinarity

Joshua Macey Foundation meetings included mathematicians, neuroscientists, anthropologists, social scientists, computer pioneers, information theorists, and psychologists. As cyberneticians strongly believe that knowledge cannot be compartmentalized, it is important to approach problems from as many different perspectives as possible. In the present UK education system, it is almost impossible to do any interdisciplinary teaching. The reasons usually given are difficulties in getting funding, timetabling, and performance measures, but no one denies the need. It is interesting that interdisciplinarity is being encouraged in research funding while evaluation is still subject based. These cybernetic ideas mirror the current thinking in diversity, leading to more innovation and creative thinking.

Nonlinear behavior

Both cybernetics and systems thinking recognize that most behavior (especially of humans) is nonlinear (now called chaotic behavior). In a nonlinear system, small changes in the input can cause large changes in the output. The usual example is that of the weather where small fluctuations of temperature or rainfall in a far-away country can cause tornados in another locality. The learning pattern of learners is generally nonlinear and thus nonpredictable, so the approach must be flexible and adaptable to many circumstances. There is an advantage also that small changes in the teaching methodology can lead to large improvements in the results.

Feedback

The notion of feedback has been since ancient times, but the new thinking by Wiener (1948) introduced circular causality where the output was fed back into the input. The simplest form of this is the thermostat, which is termed a self-regulatory system, but Wiener advanced the idea of a self-adaptive system where the targets of the system can be identified and when needed changed by the system itself. An example is "Assessment for Learning," where assessment will feed into future learning for the student (Black et al., 2003).

To fully appreciate the power of Systems Thinking, it is important to look at the other major paradigm, which is "Scientific Thinking." This rests on the shoulders of three giants: Descartes, Galileo, and Newton. Descartes (1596–1650) advocated the idea of analysis, i.e., the process of breaking down a complex problem into simpler parts. When the individual parts are solved, the individual solutions can be reassembled as a solution to the original, bigger, problem. As seen from Ackoff's (1971) definition of a system, this cannot be done with complex problems

because every part depends on other parts. An alternative (used in System Thinking) is synthesis, which is putting things together rather than taking them apart. Analytic thinking has been used for so long that it is difficult to accept that it does not work, but if one looks at the major problems of the world today—climate change, destruction of the environment, and nationalism—the deficiencies in the analytic method are clear. The ideas concerning analysis and synthesis have important repercussions in how professionals teach.

Galileo (1564–1642) was the great experimenter. He initiated the concept of hypothesize test—theorize. There has been much research by von Foerster (1982) on the relationship between the measurer or experimenter and the measurement obtained and the results indicate that an experiment is not independent of the experimenter. Nevertheless, what has survived from Galileo's work is the plan–do–check–act (PDCA) method (Tague, 2005). This PDCA was adopted by the Lean philosophy (Liker, 2004) and is often called "the Scientific Method."

Newton (1643–1724) assimilated the ideas of Descartes and Galileo and combined them with newer areas of mathematics such as Calculus to produce a theory that was revolutionary and brilliant. It united many branches of science and could explain seemingly different phenomena such as the orbit of the moon, tides, comets, and gravity. Space and time were absolute (as opposed to relative). A major plank in this theory is that of single cause and effect, or "determinism." As with the analytical method of Descartes, the major problems of the world today, such as climate warming and environmental change, do not have single causes and need a multidiscipline approach.

EXISTING LEARNING EPISTEMOLOGIES

Existing epistemologies that resonate with the theories discussed above can be seen in the work of the cybernetician Gregory Bateson (1972) and the psychologist Chris Argyris (1991). There are also contributions from the work of two pioneering educationalists: Maria Montessori (1994) and Jean Piaget (1969).

Gregory Bateson (1904–1980), an "eminent biologist and systems theorist," describes his work as an attempt to illuminate "the barriers of misunderstanding which divide the various species of behavioural scientists." He classified five levels of learning (Bateson, 1972). Level 2 allows corrective changes in the set of alternatives from which choice is made. For machines this would be self-corrective systems. This is often called "learning to learn." Learning level 3 is change in the process of Learning 2, e.g., a corrective change in the system of sets of alternatives from which choice is made. This would correspond to what is called "a paradigm shift." Many current pedagogies are sited in level 1, which is a simple feedback loop but, in this article, it is advocated that pedagogies should be sited in level "Learning level 2," i.e., their primary function should be to teach people how to learn. Bateson (1972) regarded learning as a systemic phenomenon that was inherently relational. The latter brings in the role of the observer—in this case the instigator and the seeker of the knowledge. Learning is seen as an emergent process. To quote Plutarch, "when the wood is ignited one cannot predict the type of fire" (Blackburn, 1994).

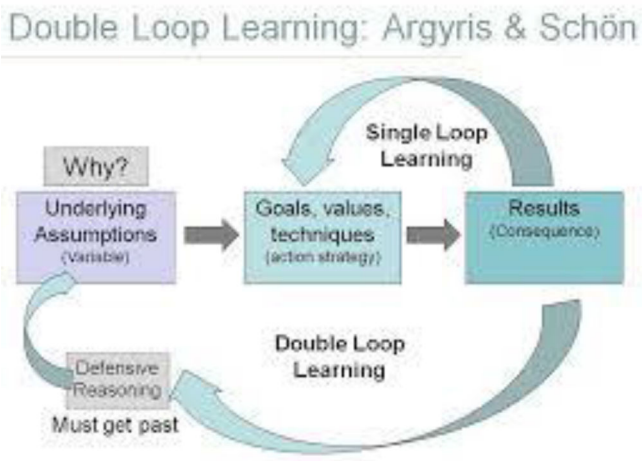

FIGURE 2. DOUBLE LOOP LEARNING (SOURCE: ARGYRIS AND SCHON)

The work of Argyris (1991), "double loop learning," has two levels. Level 1 is equivalent to a single feedback loop where a situation is resolved by an action that clarifies the situation. As humans, they have a basic need to develop a set of beliefs about why things are the way they are (culture). But knowing this desire to understand the world around them, they need to be careful about the information and experiences they are using to create these "beliefs." Argyris (1991) found that there was a difference between what people actually believed and what they professed to believe. There are social pressures to "follow the herd." Double loop learning tries to identify the real beliefs, and this creates a second feedback loop. This results in a second feedback loop (level 2) shown diagrammatically in Figure 2.

Here the context of a learning situation is examined (mental models). The organizational culture plays a large role in any learning, and, if new learning is needed, then the culture must be changed. The psychologists Bavelas and Leavitt showed in a famous set of experiments in the 1940s that if you do not tackle these primary beliefs, one can end up with beliefs that have nothing to do with reality, but one believes just as vehemently as a cold hard fact

(Mulder, 1960). It also links neatly with the mechanisms of the constructivist brain. This is known as Cognitive Dissonance (Festinger, 1985; Freeman, 1978). What is needed is management or guidance rather than control. This recalls the idea of a steersman or, in modern parlance, a "mentor."

Valiant attempts to adapt the traditional pedagogy along these lines in schools were made by Montessori (1994) and Piaget (1969). Montessori showed that pupils were quite capable of learning on their own with the help of a teacher as a guide or mentor. They responded well to choose, i.e., choosing what to study and the manner in which they do it. This is not popular among educators as it is much more difficult to assess and is much more time-consuming than traditional methods. The modern education system decides on the content of the knowledge, the method that this will be imparted, and the results that are correct. It teaches at Bateson's level 2 rather than level 1, which produces knowledgeable robots with little adaptability to different circumstances. This theory involves connecting with the emotions.

Piaget's (1969) influence lay in his theory that there are levels of cognition and that people will not learn unless they are mentally at the cognitive stage to understand what is being offered. In other words, if someone does not understand a concept, it does not necessarily imply ignorance but maybe that the learner is not yet ready for that learning. In education, it can be interpreted as meaning that learners must be ready, i.e., mentally prepared, to receive the information that is being taught. They must understand WHY they need to know before they learn to know. This connects with the ideas of Bateson (1972).

A recent addition is online learning. Online learning is not new. It has its origins in the US Army, where it is widely used in the training of new recruits. Over the last 20 years, it has grown in popularity, and the lockdowns caused by COVID-19 have greatly intensified the use of online learning. However, the approaches often used in online learning do not encourage active learning or lead to deep understanding. This is exemplified by the early versions of MOOCs, which were mainly content based with little interaction required from the learner. This situation is now changing and has been driven further by the onset of the COVID-19 pandemic. Technology-enhanced learning (TEL) is now being actively adopted and researched to provide a more engaging and interactive learning experience (Passey, 2019).

A NEW PEDAGOGY

Any new educational approach should be set firmly in Level 2 of Bateson's taxonomy (learning to learn) and enable learners to take charge of their own learning. TEL can be used to engage the natural, creative side of the learners. According to Philipps (1997), Laurillard argues that the only use of technology which can meet these aims is the "multimedia tutorial simulation," characterized in terms of guided discovery learning. Laurillard's (1993) schema is based on forming an information-rich environment in which the learner has control in discovering knowledge, but the discovery is supported and scaffolded by extra guidance functions that provide support and feedback for subsequent learning. These functions are analogous to the coaching and scaffolding at critical times proposed in the Situated Cognition Theory. Laurillard (1993) argues that different media forms have different affordances, i.e., provide a different level of support for various kinds learning experiences. She identifies five media forms: narrative, interactive, communicative, adaptive, and productive. According to Conole and Fill (2005):

> "Narrative media tell or show the learner something (e.g. text, image). Interactive media respond in a limited way to what the learner does (e.g. search engines, multiple choice tests, simple models). Communicative media facilitate exchanges between people (e.g. email, discussion forum). Adaptive media are changed by what the learner does (e.g. some simulations, virtual worlds). Productive media allow the learner to produce something (e.g. word processor, spreadsheet)." (pp. 7–9)

This system and any other learning system need to address the issues of collaboration, curiosity, control, and context.

COLLABORATION

In the authors' views, the ability to work alone is not a bad thing, but it is more important to learn to work cooperatively. The Netherlands is currently trying to change its university funding system to reduce competition between academics for research grants by cutting the time spent on largely unsuccessful funding applications. Strong incentives should therefore be created for learners to communicate with other learners. This could be verbal communication or the use of modern technology and social communication devices to connect to their peers in other faculties, universities, and countries in either a synchronous or asynchronous manner. The benefits of this communication mainly arise from the peer-to-peer learning that takes place during these exchanges.

Learners need to be encouraged to work together in one large group or small teams. Intellectual property rights can be an issue, but it would be better if all knowledge that is discovered is shared between the whole group. This fits

with the concept of open education. Learners teach each other, and in doing so, they must uncover the ideas and concepts behind their own beliefs, thus becoming tutors themselves and utilizing, albeit unconsciously, Argyris's (1991) double loop learning cycle. Any new pedagogy should emphasize synthesis rather than analysis. The systems thinker, architect, and futurologist, Fuller (1961)invented the term "Tensegrity" (tensional integrity), which has applications in education where he believed that if one could construct a state of "creative tension" among the learners, then new ideas would emerge. It has strong links to the "Gestalt" theories in psychology (Richert, 2018). Even the poet Shelley defined poetry as a synthesis of myth, metaphor, and reality (Taylor, 1919).

CURIOSITY

Objectives can be set for the learning, but they need not be precisely proscribed. The learning process should be allowed to follow its own path in a Montessorian or Piagetian manner. The group must have freedom to experiment and pursue new ideas within the boundaries of the study. This encourages interdisciplinarity and creativity. It incorporates the best of Montessori (1994) and Piaget (1969) ideals where learners can make choices in their learning. They set the agenda and the way they learn. The learners are encouraged to take charge and have responsibility for their learning. It recognizes the nonlinearity of the learner behavior and allows it to flourish. Because all knowledge is interconnected (holistic), the exact, precise knowledge that will be learnt cannot be defined in advance. It is emergent rather than determined.

As an example, in economics, supply and demand is an important topic. There are many established ways of looking at "supply and demand" from simple linear curves to utilizing sophisticated mathematical techniques. It is important to find the right question. The question "What is the law of supply and demand?" is not a good one as learners can easily and quickly find the answer on the Web and the learning is over. A better question would be, "How does supply and demand work?" Learners would then maybe find several explanations that they have to understand. Even better would be, "What is the best way of explaining the behaviour of supply and demand?" This has the extra advantage that the learners have to start making judgments. A very good question (in the new pedagogy) would be "Devise a way of teaching your peer how supply and demand works." This combines all the previous comments plus their knowledge of how they themselves want to be taught. The learners will be given the opportunity to start wherever they choose and to use their own experiences of "supply and demand." It could include ethical, moral, and ecological aspects to the problem. The experience of the guide (mentor) will be essential here.

CONTROL

To enable the learners to learn from each other, teachers must cease presenting themselves as professors or experts but more as a guide for people who wish to discover new knowledge that will help them in their career. (One recalls the origin of the word Cybernetics—the Greek word "kubernētikós" meaning steersman.) Their function is that of a controller of variety—helping the student to attenuate the variety of knowledge that exists and amplifying their ability to access it. The teacher is no longer setting up the experiments as this would contradict second-order cybernetic principles. Instead the learners are themselves the experimenters, but because of the collaborative and communicative aspects of the pedagogy, they can realize the subjectivity of what they are doing.

For online learners, there is more than the subject to learn: They need to learn the technical way of using the eLearning system that they are using. It is therefore important to provide a model of eLearning in which the participant can quickly explore the system and also learn how to communicate online (Marengo et al., 2016; Phillips, 1997). Salmon (2000, 2002) has developed a model of structured eLearning activities that has the purpose of creating greater interaction and participation between participants in eLearning courses. She believes, and has experienced, that for online learning to be successful and happy, participants need to be supported through a structured developmental process. The model is a "scaffolding" model. Scaffolding means gradually building on participant's previous experience. A structured learning scaffold offers essential support and development to participants at each stage as they build up expertise in learning online.

Context

Because of the cybernetic view that all knowledge is interdisciplinary and should encompass a holistic perspective, the subject matter should include ethical, moral, and social and economic aspects. Using the success of smart algorithms and robots, the emphasis in teaching can now be less on HOW to do something by WHY one would want to do it, or even, should one be doing it. Obvious examples are nuclear power, genetic cloning, and fracking.

Building on these influences, a new pedagogy would follow a holistic and interdisciplinary approach.

It would use open source material in so far as the students will take advantage of the Internet and all it provides in the spirit of Wikinomics. Students take charge

of their own learning and literally "teach themselves." There should be management or guidance rather than control. The students are prosumers. There needs to be maximum interaction and communication between students (peer-to-peer) and the learning should use the latest technology (mLearning and gamification).

These features are heavily influenced by cybernetic and systems thinking; however, the scientific process is still important. Learners will be encouraged to follow the PDCA philosophy—plan, do, check, act—which does not contradict any of the above features. It is an example of recursive learning as the cycle can be applied at all stages of the learning.

Another link with the constructivist theory is the role of emotions in learning. There is much work being done on what is termed "emotional learning," and these ideas must be incorporated into any new pedagogy. These ideas are extensively documented (Goleman, 2019). There are four major activities—self-awareness, self-management, social awareness, and relationship management.

> *According to numerous studies over the last 30 years, Emotional Intelligence (EQ) is the most reliable indicator of success. It is more highly correlated with high performance at work than either IQ or personality type.* (Rodes et al., 2017)

When one is becoming more emotionally intelligent, one is increasing the granularity of one's concepts that enables the brain to make better predictions. Beer (1997) would say one is increasing the variety inside to cope with the enormous variety outside. Asby's law (1956) will apply here.

Part of this process could be termed "recategorization," which is the more concepts one knows and the more instances that one can construct, the more effective one can recategorize in this manner to master their emotions and regulate their behavior (Gaertner et al., 1993). One can only guess how other people feel, so learners must be encouraged to talk about their feelings (Goleman, 2019). Learners must define their concepts such as what is work, how does one measure motivation? It is now agreed that people in close contact do synchronize their emotions.

EVALUATION

Any new pedagogy must be able to respond to the following observations:

There Are Certain Fixed and Determined Facts That the New Generation Need to Know

The proposed pedagogy is too free—one does not know where it will lead.

One must question if there are any such incontrovertible facts. For example, consider research into dinosaurs. Over the past 50 years, the "facts" have changed, such as: they did not exist; they were slow-moving, cold-blooded reptiles; they were hot-blooded, fast-moving reptiles; they were smooth skinned; they were feathery; they could not adapt to a changing environment; or, they were wiped out by a meteorite crashing into the earth. The same could be said about that most logical of all subjects—mathematics. In the 1960s, nonlinear behavior was classified as "pathological" and now it is the cornerstone of modern mathematics. Since the arrival of the computer, mathematics has changed out of all recognition and most of the mathematics taught in UK universities in the 1960s are no longer used. What is important is the way mathematics can be applied and used to model phenomena. The same comments could be made about architecture (it is impossible to build the 829.8-meter-tall Burj Khalifa in Dubai with classical architectural techniques), medicine, economics, and the biological sciences. Much knowledge is quickly out of date. It is very difficult to decide what "facts" should be put into learner's heads. Part of the new learning includes past knowledge, so the learner would not be ignorant of the "accepted facts," but the new pedagogy would allow further exploration. As Rumsfeld famously said, "it is the unknown unknowns that are interesting" (Rumsfeld, 2011).

Can Such a Pedagogy Be Applied to All Areas of Knowledge

- This is possibly a valid comment. Certainly, dentists and doctors need to know what is currently best practice, and the time for exploration and creative experimenting is best left to the research laboratory. But this article is not dictating what precise formats be for the new pedagogy, only general principles. The authors certainly do not insist that it should be applied willy-nilly to every situation.

What Is the Balance between Competition and Cooperation?

In the authors' views, the ability to work alone is not a bad thing, but it is more important to learn to work cooperatively. Margulis (1970), in her work on biological symbiosis, and Ostrom (1998), who received the Nobel Prize for her work on cooperatives, both advocate the evolutionary and social need for cooperation. The Netherlands is currently trying to change its university funding system to reduce competition between academics for research grants, cutting the time spent on largely unsuccessful funding applications. Changes proposed in a

With the changes in the education sector forced upon institutions through the Coronavirus situation, many are now reevaluating their approaches to education. The time is right for change and to adopt new ways of learning.

major review of the education sector mark a turn away from a competitive philosophy, reflecting growing Dutch concerns that the costs of pitting academics against each other in pursuit of funding have begun to outweigh the benefits (Jongbloed et al., 2109).

Is Credible Assessment Possible?

The idea of measurement and assessment is ingrained into the culture. Systemic thinking (backed by the quantum theory) shows that what is measured is greatly influenced by the measurer. They are not independent. The question is—"what are we trying to assess?" The emphasis of the new pedagogy is to teach learners how to learn. This cannot be assessed by traditional methods. If assessment is desired, then new ways of doing it must be created. The learners could even be assessed on their mistakes, in the sense of what they have learnt from making them. Assessment procedures should not dictate the teaching. The assessment should be of the journey—not the destination.

Is Certification Needed at All?

Certification is traditionally a degree for example, but does it need to be? There are digital badges now as part of MOOCs. What is it that people need to have? The authors suggest they need some evidence of their learning, but the format this could take is an open question. Employers are already rethinking their approach as there are currently known certifications, e.g., BSc, MSc, PhD, and professional body accreditations, e.g., Chartered Engineer. This raises the question of quality assurance. New procedures would have to be thought through. It is the quality assurance that is probably the biggest issue for new evaluation as one can now register for online courses but what is their value? Is the university name enough?

Ideas emanating from the system paradigm can be incorporated into a new pedagogy for higher education.

How Can Learners Know What They Should Study? They Need Experienced Teachers

It is true that a novice will not have the same holistic view of the subject as an expert. But this is one of the roles of the teacher—to guide the learners. Thus, the teachers can use their experience and knowledge to guide not to direct. If the learners make mistakes, these will become obvious and the teacher can in a non-judgmental way enable the learner to learn from these mistakes.

It Would Be Very Difficult to Run Such a Pedagogy in the Existing University Structure

In fact, the current organizational structures at modern universities are incapable of conducting such a pedagogy (Strachan et al., 2020). To do so will mean a major restructuring. Despite these difficulties, the authors believe it should be done.

PRACTICE

The ideas expressed in this article encourage creativity, and thus a definitive process will not be set out. Several learning ideas have been explored and linked to the new constructivist model of the brain. It is left to the group (learners and teacher) to agree on objectives and suitable methods for achieving them. Some suggestions are now given.

- An optimum size for a group is generally agreed to be five members, but still there is a danger that some students will dominate, and others will be in the shadows or even opt out. Part of the learning process will be the ability of the learners to deal with this. Soft skills (which include group dynamics) should be a voluntary part of the process. Bavelas (1951) showed that more communication is achieved when there is a central point. This could be the mentor. The central point is not a leader but just enables the flow of information.
- There will be sessions on emotional intelligence.
- The process could include peer-to-peer interaction using blended learning. According to Rossett and Frazee (2006), the instructor will cease to be the central

focus and the primary disseminator of information but respond to questions while the learners defer directly to the instructor for guidance and feedback. Instead of individual lessons focused on an explanation of the traditional "supply and demand" theories. Blended learning will intentionally shift the instruction to a learner-centered model who will explore the topic in greater depth and in contexts meaningful to them. They can then make the jump to generalized conclusions, i.e., it is an inductive rather than a deductive methodology. In this method, content delivery may take a variety of forms—online videos, collaborative discussions, digital research, and text readings may be used. Current technology (such as mobile phones and social communication channels) also allows for the content to be delivered outside the classroom at a place and time of the learners choosing. Workplace activities will vary but may include experiments, peer reviewing, and project-based learning. Because these types of active learning allow for highly differentiated instruction, more time can be spent on higher-order thinking skills such as refection. The instructor who is interacting with the participants in a flipped situation will be more personalized and less didactic, and the learners will be actively involved in knowledge acquisition and construction as they participate in and evaluate their learning.

- An important part of the blended learning experience is software that enables the participants and their mentor to communicate frequently and easily, and also provide access to all the learning material. This is the role of the learning facilitator (LF), which will be available to all participants. An LF should have the following three functions:

    - It is a repository of all materials that will be used in the course. This includes the videos, the presentations, selected reading, and examples from practice. The user can customize the software and add to it relevant information that is felt to be useful to the studies.
    - It is a communication device that enables the students to communicate with each other and with their mentor. These communications can be accessed by the mentor and will be used as part of the formative assessment.
    - It is a log of the Student involvement on the course and can be used in the assessment process.

The assessment could have a normative and evaluative part. The normative part will be provided by the LF. The assessor will be able to see the extent of the cooperation of each learner. Those who fully communicated with their peers and mentor and joined in the collaborative work can be rewarded. The evaluative part will be a significant reflective essay of around 20,000 words where the learner will assess what has been achieved, what he has learned, what mistakes were made, and how the results affect his attitude to the wider context.

CONCLUSION

The exponential growth of technology, robotics, and artificial intelligence means that the world is rapidly changing. Education is not exempt from this trend, and new ways of engaging and teaching must be investigated. This article looks at several theories and philosophies that underpin "learning," especially those theories coming from the system paradigm that the authors think is essential for today's world. Based on these theories, a new pedagogy has been proposed and an example given of how it would work. With the changes in the education sector forced upon institutions through the COVID-19 situation, many are now reevaluating their approaches to education. The authors believe the time is right for change and to adopt new ways of learning. This article has outlined the proposed approach based on their experience and grounded in existing theory.

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