The Future of Learning Institutions

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The very nature of the knowledge society presents a challenge for all learning organizations from schools to higher education. Knowledge technologies have entirely transformed the relationships between the individual learner and the public stock of knowledge thus making the requirement for learning organizations obsolete.

This essay analyzes the learner traits pertinent to learning first, the new nature of knowledge in the digital era, and the curriculum and pedagogy that mediates learning within the learning organizations. This analysis concludes that while sophisticated knowledge technologies can support adaptive personalized education, they cannot elicit individual traits such as the capacity for independent learning, general intelligence, personality, or emotional construct. Thus human diversity and individual differences will stay widely distributed and will demand the complex human services provided by the learning organizations.

Yet in order to meet the challenges created by the knowledge society, far-reaching changes must take place in their basic vision and concepts. A model for these changes is suggested

Keywords: learning organization, knowledge society, knowledge technologies, learning system, cybernetic pedagogy, future

INTRODUCTION

The vision of a knowledge society projected toward the end of the 21st century has become the reality of the third millennium (Macluhane, Powers 1989; Harari 2018). Technology has catalyzed the transformation of culture, society, and the economy, resulting in globalization (Tomlinson 1999). Knowledge has become a major source of capital and the driving force behind all-encompassing changes from individual lifestyles to global networking. Learning institutions, such as formal schools and higher education, should constitute a central role in the emerging knowledge society as major participants in the production and dissemination of knowledge. However, the very role of learning institutions as guardians of knowledge is being severely questioned as knowledge moves into the digital realm and social networks, and much of the production of knowledge is machine-driven (Future Perfect, 2015).

The future of learning institutions is extensively discussed (Task Force 2018; Henny 2016) and the content and nature of their habituation lay along a wide spectrum bridging two extreme scenarios. The pessimistic scenario is that traditional learning institutions will become obsolete. Knowledge technologies will replace teachers as providers of knowledge, the school and campus will stop being needed as sites of learning, and the classroom will be replaced by distance learning, social networks, personalization, choice rather than compulsion, and a top-down curriculum will dominate the learning scene.

At the optimistic end of the forecasting spectrum, traditional learning institutions will survive the technological revolution as they did when radio, television, calculators, and typewriters were assimilated into existing structures. Currently, the corona crisis has forced learning institutions to accept distance learning technologies into their programs while maintaining their full identity. Because learning institutions have a considerable social element of learning and, at the same time, serve a crucial role in the existing social order, their existence has not been questioned. In this paper, I will analyze the validity of forecasting the future of learning institutions, which spans between the two extreme visions described. The analysis will include both the theoretical foundation of learning institutions and design principles for the future that emanate from the universal underlying framework.

The Goals of Universal Learning Institutions

Homo sapiens are born with the capacity to learn; however, the collective universal stock of knowledge is neither encoded in the genome nor inherited (Plomin 2008). Therefore, we have to and we are learning during our entire life in order to function and survive in our complex physical and social environment. Thus, learning is the goal of every individual, everywhere, throughout our entire life cycle. Two kinds of social institutions were established during the 19th century to mediate organized learning: normal schools (K–12) and higher education institutions. Today, these institutions serve more than 2 billion students and consume an average of 5 percent of countries' GNP. The universal goal of learning institutions has been and still is to optimize the mediation of knowledge between the collective stock and the individual learner, to comply with national needs, and to provide personal choice (Chen 2001).

The Learner First

Most of the publications regarding the future of learning institutions, whether they are research reports, brain storming documents or policy papers, focus on what it is that the new social order requires, i.e., new subjects, new skills, and new strategies (Schleicher 2019) The Incheon Declaration published by UNESCO, the World Bank and others, is a good example (UNESCO 2015). This policy paper is based on forecasting the future of social and economic requirements and extrapolates learning goals for current learning systems. The Incheon policy paper was adopted by as many as 164 Ministers of Education. However, this influential report ignores completely the poor students who must withstand the high expectations of this report. It is incomprehensible that a design of a future learning system will evade the question of whether or not learners themselves can cope with the new expectations set by the new vision. This is why consideration of both the individual and the population of learners is crucial to the design of a learning system. I will briefly summarize the scientific understandings of learner traits as they pertain to educational policies and practice. Learning and behavior are regulated by three biological systems (Plomin et al. 2003). The human genome consists of 33,000 genes containing all the information required to develop a viable human being (Winchester 2020). The entire set of genetic traits is universally encoded in the DNA molecule. The genome is a highly stable entity throughout ontogenesis and is susceptible to change only between generations. Because the genome controls about 70% of variance in human intelligence, it is practically regulated innately (Galton 1869, Herrenstein, Murray 1994). Most human learning traits are regulated by a polygenic principle whereby multiple genes regulate a single trait. Thus, a single mutation produces only a small change and the resulting individual differences assume a continuous distribution in the population in what Francis Galton describes as a "normal distribution" (Galton 1869).

Recent comparative studies like and Pisa (2018), based on millions of subjects from different countries and cultures (OECD 2019), confirm the universal normal distribution of learning outcomes in science, mathematics, and reading. This, in fact, is empirical evidence of the universality of a normal distribution of mental abilities in the general population. Thus, the universal principle of human diversity is a very different concept than inequality. The idea of affecting the distribution of individual differences through educational measures, however, does not seem to work. Yes, biological constraints of learning traits are deterministic and must be taken into account when designing current and certainly future learning systems. However, the genome is but one of the three systems regulating learning and behavior.

The second mechanism regulating learning and behavior is the emotional system. In contrast to the genome, the emotional system is open to environmental signaling. Evolutionarily, emotions came to serve our survival needs (Vans coy 2018). It was Darwin who demonstrated a set of basic universal emotional states that are not dependent on either culture or race. Emotions can be defined as "knowledge without words" or, in modern terminology, "non-declarative" or "tacit" knowledge (Kendal 2000).

The infrastructure of the emotional system consists of three sub-systems: the emotional brain (the limbic component), the endocrine system, and the autonomic nervous system. Emotions are conveyed analogically by molecular signals that spread all around but are deciphered by specific receptors that activate non-declarative knowledge such as positive or negative mood, love, aggression, action, or motivation. Kahnman uses the term "system 1" to designate the autonomous nature of this kind of behavior (Kahnman 2000). The emotional system is heavily involved in the learning process. Positive emotions, such as pleasure, satisfaction, and motivation, can enhance learning outcomes, whereas negative emotions, such as depression, fear, and hunger, will have a damaging effect on learning achievement. All this said, the emotional system has not yet become part and parcel of educational theory and practice, and the complexity of this system has only recently drawn the attention of the educational community.

The third system regulating learning is the cognitive system situated mainly in the frontal brain and networked with the senses to process environmental signals. This is the system that drives language, numeracy, problem solving, and decision-making, and has enabled Homo sapiens to elevate themselves as the planet's dominant species. The new knowledge concerning human learning and behavior must be taken into account when innovative practices concerning teaching and learning are being suggested. The enormous complexity of biological systems regulating learning and behavior requires educational policies to be based on the unity of knowledge beyond the culture gap. Understanding the potential and constraints of learning by the individual and the population is critical to the design of any organized social system.

It is high-time that learning institutions reframe their vision and strategies, and focus on modern scientific understanding of the learner and learning. The unity of knowledge demands an educational vision that integrates both liberal arts and science into a broad and effective paradigm of universal learning.

Currently, the formal educational concepts regarding learning are twofold:

(1) The first is the concept of intelligence (Herrnstein, Murray 1994). This psychometric parameter assumes a single brain entity designated "G," which stands for the mind's overall mind operational capacity. Evidence for this universal entity comes from factor analyses but no support for its existence has come from brain research.

(2) The second and alternative concept of regulation of our mind is modularity (Fodor 2000). Here, the notion is based on evidence coming from distributed regulation based on domain specificity and brain mapping by computational imagery.

The idea behind modularity is that the genome produces different tool kits or modules for processing specific domains of knowledge.

This construct is also supported by the presence of many human "talents," which indicate domain specificity, e.g., musicians, mathematicians, writers, painters, and athletes. All Nobel Laurates are distinct in a single domain only. Multi-talent and polymaths, like De-Vinchy or Ghete, are very rare cases in human history.

However, the analogy with information processing systems suggests that two concepts might serve a complementary role. The universal G serves as a system management or executive function role while the modular tool kits serve the specific knowledge domains. So far, there is no evidence that either IQ or modularity are sensitive to teaching as they are mainly regulated innately. However, current educational policies insists we can change human nature instead of adapting the policies to the reality of learning regulation systems.

Another crucial concept is the change over time called "child development." Child development research tells us the story of cognitive trait emergence. Perhaps the stage theory of Inhalder and Piaget is the one relevant to consider (Inhalder, Piaget 1958). Their studies demonstrated that rationality is universally regulated by a biological clock that unlocks different cognitive traits at specific and universal age stages. For the sake of educational policy, the most important fact is that all children attain concrete

learning and thinking skills by the age of 11 or 12 years. However, as recently shown, only 25–30% of the population continues on to develop formal thinking skills (Babay 2018). The implications of these findings on pedagogical strategies are far-reaching. Most of the pedagogies enacted at learning institutions aim at formal thinking, whereas most of the students within the population are concrete thinkers. Indeed, higher education practice is selective in order to leave out most of the concrete thinkers. The alternative to this policy is to extend concrete pedagogy and, thereby, extend social equity.

The complexity of learning regulation leads to the following conclusions:

a. We have to distinguish between potential capacity to learn, which is regulated by the genome, and the process of learning, which is open to environmental signaling.
b. The capacity to learn is normally distributed in all populations and constitutes individual differences for learning.
c. Individual differences are universal phenomena and, therefore, biologically regulated.
d. Learning is highly susceptible to emotional and social factors, and this fact should be taken into account when learning policies are considered.
e. Concrete thinking is a constraint on learning that demands formal thinking.
f. Adaptive education is probably the answer to the diversity of individual differences in the population.

The overall conclusion is that entire teaching policies must be reconsidered, reframed, and adapted to current understandings of the nature of human learning.

THE CURRICULUM

The classical notion of curriculum is that you can somehow represent sections of the collective stock of knowledge by selecting and packaging small models of the real knowledge. This was and still is a very naïve concept and inappropriate to our understanding the complex structure of the universal stock of human knowledge.

The most dramatic change that characterizes the 20th century is the logarithmic growth of the human collective stock of knowledge (Meige, Schmidt 2015). This growth is also described as the "explosion of the knowledge society." While industry, markets, cultures, and services respond to the far-reaching changes by assimilating knowledge technologies, learning institutions for which knowledge is their bread and butter have so far continued their traditional existence without any significant change. The following far-reaching changes in the structure, social production, and dissemination of knowledge must be reconsidered:

1. The structure and organization of the universal stock of knowledge is transformed from linear into complex constructs.
2. The production of new knowledge is extended from formal research institutions to a vast number of more than 2 billion users of the internet and multiplied by smart machines.
3. Digital knowledge is focused on representing declarative symbolic knowledge while evading non-declarative, concrete knowledge.
4. Search engines and sophisticated algorithms enable adaptation of knowledge packages to individual differences and far beyond disciplinary frameworks.
5. Theoretically, the universal stock of knowledge is accessible to the individual learner anywhere, any time without teachers and teaching.
   The immensity of the knowledge space requires choice and selection for the independent learner. However, the constraints of information overload and the chaotic structure of the new knowledge sources severely limit autonomic independent learning.
6. The open curriculum constellation experience, such as offered by the Open University or MOOCS providers, suggests that only a small percentage of the student population can engage in independent studies. Thus, despite the advantages of knowledge technologies, it is the students' constraints that create the demand for learning institutions and their teaching practices.

7. Shannon's information theory established the entropy principle, i.e., more order, less information. Therefore, reducing information overload via organized disciplines is crucial for effective learning as the new chaotic structure of digital knowledge is prohibitive for effective learning.

The mathematical theory of information has strictly defined information in units called "bits," which are confined to their quantitative dimension. The semantic aspects of knowledge are still enigmatic and a matter for neuroscience and philosophy to solve.

The new knowledge scene described so far requires an urgent reframing of the entire theory of the old curriculum theory and base it on new quantitative and qualitative dimensions of the human collective stock of knowledge, and relationships with individual learning and memory traits.

Knowledge Technologies

Technology is an extension of man (Ellul 1964, Heidegger 1993). Writing systems, the first knowledge technology, were invented about 4000 years ago. The capacity to read and write is not encoded in the genome like language, thus it must be learned. Writing technology enabled humanity to preserve knowledge outside the brain and establish the universal stock of knowledge. Printing technology, which was invented during the 15th century, enabled the production of redundant knowledge and the process of knowledge democratization. This technology signaled the beginning of the learning organization. Electronic technology, such as radio, telephone, and television, appeared at the beginning of the 20th century and enabled the extension of human communication beyond here and now. At present, an integrated knowledge technology comprising the production and dissemination of knowledge is the major catalyzer of the new social order and transformation of personal lifestyles. This is the essence of the new knowledge society. At the very center of the new knowledge society stands the change in relationship between the gigantic knowledge stock and individuals' memory capacity. The mediation of knowledge between the two frameworks presents a major challenge for the learning institution in the third millennium. Here are the present challenges:

1. The collective knowledge stock has moved from the library to Google. While access and search for specific knowledge are theoretically free, personal constraints are practically prohibitive.
2. The internet enables learning everywhere, any time, and for every purpose. Once again, most learners become lost in the knowledge space and cannot leverage the independent search and choice offered by the net.
3. Artificial intelligence and learning analytics enable more efficient learning as well as knowledge production outside the brain. The promise of these technologies has yet to be fulfilled within the domain of learning and teaching.

Now here is the question: Will knowledge technologies replace existing learning institutions or integrate with them, thus changing their vision, structure, and function?

Learning Institutions of the Future: A Design for a Changing World

I have discussed the nature of learning organizations from the view of transformation into the knowledge society. This section constitutes both a justified vision and a design that rests upon the modern scientific understanding of the universal aspects of learning and knowledge.

From Schooling to Learning Systems

It is impossible for a single school or campus to handle and represent the entire range of human knowledge. The present answer to this issue is "specialization." MIT offers mainly an engineering curriculum while Harvard provides curricula in liberal arts, social sciences, and natural sciences. High schools specialize in either academic or vocational education.

Knowledge technologies enable the organization of learning in a much more effective and richer mode by transitioning from a single-cell mode to an organismic whole or, in other words, from a single learning institution to a learning system (LS).

The candidates for participation in a learning system are:

1. Individual learning
2. Home or family schooling
3. School, campus (a learning organization)
4. Workplace (industry, services, commerce, etc.)
5. Leisure industry
6. Global learning networks

A learning system consists of the aforementioned elements weaved into an integral whole system that enables choice and the construction of a personalized curriculum with an adaptive pedagogy. Independent learning can take place anywhere and at any time. Unfortunately, only a small fraction of the population (5–10%) demonstrate the capacity to learn independently. Therefore, organized learning will remain the major format for learning and learning institutions will continue to exist.

The single learning institution, campus, or school will remain the major learning site; however, as a participant in a learning network, it will have to serve the following roles:

A. Provide a core curriculum.
B. Develop social learning skills.
C. Hold legal responsibility for the individual learner within the LS.

By relaxing the existing organizational entities, a learning system can be established that enables students to make choices beyond the core curriculum and study specific subjects in a network of relevant subjects that can include either specialized schools (art, science, music, high tech), cultural centers (museums, natural reserves, tourism, etc.), relevant workplaces (social services, science labs, industry, etc.), and international learning networks (e.g., Coursera, Edx, Google, etc.)

From a Linear Unidirectional Curriculum to a Complex Multi-Faceted Knowledge Space

The organization of knowledge outside the brain is, in principle, an engineering problem. The public stock of knowledge is an ever-growing entity, spread globally, produced by man and machines, encoded in print, and electronically and distributed by learning institutions, libraries, and broadcasting and social networks. The traditional categorization of knowledge by discipline covers only a portion of the new knowledge stock. This new stock serves as the "world brain" and is, indeed, organized as a complex, multi-faceted space rather than a linear structure. The new relationships between learners and knowledge require a whole new theoretical framework to replace the present notion of curriculum as the mediator between learners and knowledge.

However, the new knowledge technologies enable every individual to interact directly with the universal stock of knowledge without the meditation of a curriculum. Will this situation spare the need for a learning organization? For a curriculum? Here is the problem. The gap between the stock of public and individual knowledge is GIGANTIC. Individual learning requires search and choices that even sophisticated tools such as Google or Wikipedia cannot provide. The constraints of innate determinants of learning limit the capacity of an individual to search and choose as necessary to construct a personally meaningful curriculum.

Thus, learning organizations are here to stay as a necessity to support, mentor, and navigate the individual through the complexity this gigantic stock of public knowledge presents. The wise tutor is still required for mentoring students.

From a Mechanical to a Cybernetic Model of Pedagogy

Currently, the prevailing pedagogy in all educational institutions is based on simple mechanistic principles. If we teach (instruct), then the students learn. Classrooms and lecture halls all follow that principle; however, the empirical evidence does not justify this assumption.

1. The distribution of educational achievements corresponds with individual differences rather than class grade.
2. A meaningful percentage of the population doesn't even complete high school requirements.
3. Within high learning institutions, the dropout rate increases from grade to grade. Less than 3% of the student population reaches graduate studies.

Thus, it is not just the teaching and faculty that determine success. With all due respect, it is the students that determine the quality and quantity of outcomes. The need to change pedagogical strategy was suggested a long time ago by Glaser in his inspiring book "Adaptive education: individual diversity and learning" (Glaser 1977). Its theoretical framework suggests a cybernetic pedagogy, i.e., feedback-based learning. Today's fast-developing knowledge technologies follows Glaser's vision on adaptive education in two ways:

(1) AIED – Artificial intelligence for education. Here the idea is to provide continuous information on the learning process for every learner and pedagogical feedback to both the learner and the teacher.
(2) LA – Learning analytics. Here the idea is to assemble a large database that covers the entire learning population, identify different learning styles, and create adaptive pedagogies for the different learner groups in different domains.

Both technologies are in their early stage of development. The major problem for both is that at the moment they are based on the learner's behavioristic manifestations and ignore the innate cognitive and emotional parameters. I would suggest that future pedagogy would rest on consideration of the triad of teachers, adaptive technologies, and learners.

The feedback system would comprise the following learner profile:

1. Learner's performance: pace and grade
2. Learner's innate parameters (independent variables):

IQ, EQ, domain specificity, motivation, developmental stage, capacity for independent study.

The adaptive feedback system should include:

- Adapting to specificity of the domain
- Rate of learning
- Mode of representation
- Guided choices
- Difficulties of problem solving
- Levels of cognitive development
- Independent vs. dependent mode of study

Ignoring the central role of the individual profile in learning effectivity is the major cause of inequity and the failure of slower learners.

I would, therefore, suggest that three frameworks for learning be established based on both social and individual orientation. These three frameworks are:

1. A core curriculum oriented toward socialization of the individual as an active participant in the community. This knowledge is compulsory and should aim at literacy, citizenship, and preparation for the world of work.
2. Specialized, personally adapted knowledge. Here adaptive education should be used to construct learning programs that comply with the distribution of aptitude and learning traits in the population, and domain specificity.
3. Knowledge by choice from the widest range in order to satisfy personal needs, talent, and priorities. The quantitative proportions among the three different kinds of curricula is a matter of social, cultural, and political priorities.

Teaching and Learning

Currently, the tradition of teaching and learning at both normal schools and higher education institutions follows the format of a production line: students and knowledge proceed in a linear timeline and students are assembled in production units called "classes." The knowledge is packed in curricular rigid templates and grouped in disciplinary molds called "departments," "faculties," or "courses."

The production line assumption is that the arrow of learning time yields standardized achievements that can be accredited by a grade or a degree. While the concept of the production line complies with the transition of raw material to a finished product, it is totally wrong to consider humans as raw material.

The following appropriate principles for the design of a learning system are suggested:

1. Young learners (up to 12-years-old) are all at the concrete cognitive stage. Up to that age, the pedagogy should contain a significant component of non-declarative knowledge studies via empirical and concrete experiences (makers, art, web, PBL, learning by doing)
2. During adulthood, individual differences are crucial and require adaptation of the teaching system to either concrete or formal cognitive stage.

The rule-of-thumb for managing an adaptive system is the 70/30 rule; i.e., the distribution of cognitive capacity in the population is roughly 70% concrete and 30% formal. This policy would open higher education to populations that are currently screened out and raise educational equity. What we will continue to see are organized groups (classes, courses) for learning, but on a more flexible scale, from very small groups (5–20) up to halls with thousand and more. An independent, individual learning style requires self-discipline and high motivation, and special skills would be accommodated via learning technologies for either a small percentage of the student population or for all on a limited section of the curriculum.

3. Choice should be the privilege for all students beyond the core; however, the knowledge age makes it practically impossible for everyone to make the appropriate choices. Smart choices should be done by combining mentors and parents, counseling, and the support of assistive technologies. This kind of combined systemic approach is still far from reality and requires intensive R&D.

CONCLUSION

Learning institutions are here to stay, serving a major role in disseminating the universal stock of knowledge and supporting the development of human capital. Learning institutions are central to the knowledge society and, therefore, the optimistic scenario will prevail. However the survival of learning institutions demands far-reaching changes that integrate knowledge technologies into their structure and function.

Changes to learning institutions in the future will include the following:

- Transition from a single school to a learning system.
- Relaxation of the rigid curriculum into three categories: core, specialized, and personal.
- Use of adaptive education to provide for individual differences.
- Extended learning sites from the classroom to learning networks.
- Placing meaning on non-declarative knowledge.
- Extended target population to promote life-long learning.
- Assimilation of knowledge technologies using an R&D strategy.

Learning institutions are at the very beginning of making the necessary changes to survive the knowledge society and knowledge technology. This essay is meant to serve as a wake-up call for both normal schools and higher education institutions.

I have discussed the nature of learning organizations in view of the transformation into the knowledge society. The major elements of schooling were analyzed—learners, knowledge, curriculum, and pedagogies—in order to provide guidance to the changes required in the structure and function of learning institutions serving the needs of a changing world.

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