Educational Technologies: Innovation or Conservation?

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ABSTRACT

Can technology be the innovation that brings salvation or, in contrast, conserve or even empower the present educational enterprise? The present paper analyses the relationship between educational technologies and educational schooling.

In the beginning, both education and technology are redefined. Technology is defined as the collective creative intelligence of mankind dedicated to solving existential problems and providing human needs. This definition draws on the Ellul Technique and Heidegger's extension of man's definitions. Technology is in the hands of the inventors and users, and it can be constructed or destroyed accordingly. The education enterprise was configured during the Industrial Revolution in the 19th century and, therefore, is based on mechanical principles. The mechanical perception of learning is responsible for the current factory schooling education model. An alternative model of schooling appropriate for live learners is suggested and compared with the present model. The nature of the effect of technology depends on the choice between the two alternatives: The factory or the living learner model. Detailed accounts of the choices indicated that the present factory model was chosen for all aspects examined. The conclusion is embarrassing. At present, most of the impact of educational technology is by conservation, disguised as an innovation. First, a far-reaching transformation of the conceptual framework of the factory model is required, and technology should be redirected to enable real innovation.

Keywords: *Educational technologies, Factory schooling. School for live humans, Innovation conservation.*

INTRODUCTION

Educational technologies are currently considered innovations that transform the educational enterprise from its present state into a highly new and effective organization.

As knowledge, represented digitally, has replaced material, it is the primary component in social, economic, and cultural transformations (Chen,1992). Metaphors such as the "global village" (McLuhan and Powers, 1987), The electronic Agora, and the "information society" (Buckland, 2017) are often used to describe the envisioned new stage of civilization in which knowledge technologies are the driving force behind new ways of human learning, Behavior, and social organization.

The educational enterprise is the major social institution responsible for producing and distributing knowledge (Chen, 2023). It has been more than thirty years since digital technologies were implemented at schools around the globe. However, the extent of change and transformation of educational institutions lag far behind the rest of social institutions such as industry, social networks, Hospitals., Commerce, finance, entertainment, and more.

The purpose of this paper is to probe into the complex relationship between knowledge technologies and the educational enterprise to understand the accumulated impact of what is considered the most innovative educational transformation, or, in educational terms, "Reform."

Defining Technology

Technology is a widely used term, and the average person seems to understand it as tangible things such as machines, tools, phones, computers, cars, etc. The dictionary's formal definition is: "The use of scientific knowledge for practical ends." This widely accepted definition ignores that technology, primitive at that time, appeared a million and a half years ago before any science existed, in the form of hand tools invented to cut food, hunt, or Neet. Aristo used the term "Techne" to describe practical knowledge as distinct from "Episteme," denoting formal knowledge. However, a philosophical approach (Heidegger,1977) defines Technology as " the extension of man to solve a problem or provide a need." The social role of technology was further defined (Ellul, 1964) as "technique": the overall human, technical methods as the game changer of society. I would like to build on these two insights and extend them by focusing on the very origins of technology as the extension of man, providing the major power for transforming society in many ways. What is the authentic force behind the extension of man is human wisdom, or in other words, creative intelligence, one of the multiple intelligences (Gardner,2004) homo sapiens were blessed with. Thus, I suggest the following definition of technology, based on both Heidegger and Ellul: *technology is the collective creative intelligence of mankind dedicated to solve existential problems and providing human needs.*

This definition provides the percept with which we can further analyze technology's role in transforming social institutions, in our case, the educational enterprise.

As defined here, technology is first and foremost a cognitive entity and, as described by Ellul, depends on the collective minds that created it. Technologies have been devised for construction, extending human life, improving the quality of life, enriching and entertaining culture, and providing literacy for the masses. At the same time, technologies have brought mass destruction, Contamination of land and oceans, endangering climate, or mobilizing urbanization beyond limits. Thus, technology itself has no goals, moral implications, or intention. It all depends on human choices.

Defining the Educational Enterprise

The Educational enterprise is a universal organization concerned with producing knowledge proficiency in the broad population. Its basic unit is the school. Schooling was founded during the Industrial Revolution, and the principles underlying its structure and function originate from industrial mechanical concepts. Thus, it is Newton rather than Dewy who is responsible for the present educational system as it is. This is a short list justifying such an extreme claim:

The students are perceived as raw material, and the school practice is responsible for the final product at the end of the production line. This is the "Blanck slate" perception of the student (Pinker,2016). The concept of Standardization is central to the schooling system. Individual differences and Diversity, which are part and parcel of all living systems, are ignored presently, as evident from the following constructs of schooling:

1) The linear organization of space (Classrooms) and Time (Lessons). Schooling functions as a production line. Structural constraints enforce similarity and order at school.

2) Psychometric measurement by standardized stick yard of achievements, Grading all from 1 to 10 for quality control. This kind of assessment ignores the complexity of human learners (Sacks, 1999).
3) A single compulsory national curriculum is prevailing—one size fits all. International comparative testing is extending the national to international curriculum.
4) Pedagogy, like the curriculum, does not adapt to the student. It is the student who must adapt to the pedagogy. Personalization or adaptive education is still in the making and will require far-reaching changes in the present system.
5) Learning is conceptualized as a mechanical transfer of knowledge from the curriculum to a container of a passive student. The theoretical theory of learning prevailing in most of the present schools is still behaviorism (Skinner,1989) and not constructivism. (Ackerman2001)

It is crucial to understand that the mechanical principles underlying the present school are responsible for most of its problems. The present school was designed as a factory and not as a social institution such as Democracies, hospitals, or supermarkets catering to individual differences and living people's social and cultural diversity characteristics. (Chen D. 2010.)

Replacing the Factory School with a Live Learners' Institution

For schools to serve properly the human population, the physical principles underlying the present educational system must be replaced by principles appropriate for Homo sapiens which is, first and foremost, a living organism. Thus, the aspired equivalent principles are expected:

- The student is an active learner, in contrast to the blank slate perception. Constructionism, in conjunction with neurobiology, is the leading theory of learning.
- Individual differences and social and cultural diversities are the rule rather than the standard perception of the student population. Therefore: time and place should be flexible.
- Psychometrics should accommodate for nonlinear individualized evaluation of proficiencies.
- The curriculum should be constructed by both compulsory segments and a wide range of segments for individual choices.
- Pedagogy should become personalized to accommodate individual differences and social and cultural diversities.

Table 1 Two kinds of schooling

Classical Schooling: The Factory Model	The Alternative: The Humanistic Model
The learner as a raw material.	The learner as a living organism.
Similarity is the rule.	Individual differences are the rule.
Schooling is organized as a production line.	Schooling is organized in a flexible open structure.
Standardization of goals	Adaptive goals
Standardization of time	Flexible time
Standardization of curriculum	Personalized curriculum
Standardization of measurement	Personalized Assessment
Standardization of Architecture	Flexible Adaptive architecture

I will now turn to my main argument: Current educational technologies are mainly used to conserve the present system rather than transform it into alternative humanistic institutions. The wide array of educational technologies is innovative by their nature, but at present, the choices are mainly directed at conservation.

There are three agendas behind the policy of investing in educational technology:

1. The educational leadership, from the minister to the school principal, drives the political agenda to gain general improvement that can get public recognition. Thus, the expectation is that investing in technology should yield general effectiveness quickly.
2. The scientific agenda draws from research and mainly aspires to use technology to improve cognitive skills (21st century skills).
3. The organizational agenda is to improve the system's efficiency to get more graduates for less expenses.

There are different reasons for different agendas. However, the policy strategy is the same: choices for technology to solve educational problems.

We Will Now Analyze Step By Step What Was Chosen Between the Two Options: Technology to Support Elements of the Present Factory School or the Alternative, Innovative Live Learners' Institution?

The first case we will examine is the choice between the perception of the learner as a passive blank slate (Pinker, 2016) or as an active constructor of knowledge. The first Skinnerian teaching machines (Skinner, 1989) were based on behavioristic theory, and the choice made was, of course, toward transferring knowledge to an empty vessel. However, when computer-aided instruction or CAI technology became available, replacing teaching

machines, behavioristic principles remained in many new platforms. One example is the drill and practice technique used in many courses based on behavioristic principles. The idea that the student must actively construct his innate knowledge is now widely known and framed as a theoretical construct named constructionism (Ackerman, 2001). However, at the same time, the big publishers of educational courses such as Cengage, Pearson, McGraw-Hill, and Scholastic (Bookscouter,2024) must obey their commercial concerns so, while maintaining advanced technologies such as generative AI to drive adaptive teaching, the entire business is directed toward the linear structure of the factory model, thus conserving the existing model. Big corporations delivering private lessons and renting textbooks, such as Chegg and Biju's, are obeying the same commercial constraints, and their success provides the best evidence for the preservation of factory schooling. The delivery of courses uses the LMS technology for administration, documentation, and tracking capacity, strongly conserving the various elements of the factory school rather than the alternative one, as the only market available today, is still the Factory school. So, this is a vicious circle: The major producers of educational textbooks, Digital learning materials, and sophisticated media depend on the existing market, which consists of the Factory model. Thus, the mutual relationship enforces conservation rather than innovation.

The next issue is crucial for the effectiveness and productivity of the learning process. The present schooling confuses the concept of equity with similarity. The present educational practices ignore individual differences and Social and cultural diversities by using the same curriculum, grading the learners by age cohorts, and evaluating their results with a single, even universal yardstick. The international comparative testing movement only encourages this trend. This policy is justified as leading to social justice; however, these practices do not yield equality in the real world. Perhaps the best evidence comes from the PISA studies based on unique, significant data sources. Despite all the efforts in all 79 participating countries to achieve "equality," the current situation tells a somber story, as seen in Fig 1.

This is evidence that the present factory practice is unsuccessful in delivering the much-desired equity. Technology was recruited a long time ago to provide an answer to the complex nature of individual differences. The early term used was Adaptive education (Glaser, 1978), and another current term is Personalized education.

Adaptive education accepts individual differences as a blessing instead of treating individual differences as a problem. Adaptive education aims to achieve equity, not equality, by adapting educational practices to individual needs and abilities. The educational technology for the adaptive task is based on three models:

The knowledge model, or the expert system, provides an individualized curriculum for the learner.

The learner model provides a profile of the individual learner. This is a highly complex demand that today ignores major independent variables such as IQ or personality. CAT (computer-aided testing) technology identifies simple dependent variables such as speed of learning, level of skills, kind and number of mistakes, or general difficulty level.

The instructional model or ITS, the intelligent tutoring system, uses Ai algorithms to assess the individual learning model and provide learning activities adapted by the knowledge model.

Despite the sophistication of adaptive education, personalization is still in the experimental stage, and its implementation is constrained by the organizational structure and function principles of the present factory school.

Finally, We Will Examine the Concept of Standardization

Standardization is a highly prevailing concept in the educational enterprise, and psychometrics provides both the theory and the practice for the measurement and assessment used in every classroom, policy decisions, and pedagogical practices. While Standardization is the rule in the physical world, it is an exception in the living world. Each living organism is different. However, even today, a whole industry is involved in continuously producing standardized tests and data that provide feedback to the learners, Teachers, school principals, Ministry decision-makers, and the broad public.

The question is, of course, whether technologies such as CAT (ASE, 2024), Data analytics (Lang et al., 2017), and generative AI (Chen, 2021) are used to change the present standardization into an adaptive educational concept or empower the present mechanical percept of the student population, namely the Factory school.

The first element currently standardized is the goals of the educational system. Goals are an essential part of every country's national policy. The goals are usually embedded in the curriculum. They are mainly intended for developing and maintaining the unique constructs of the national culture, such as language, national narratives, and religion, while the span of individual choice is minimal. The comparative international testing projects and the globalization process intensified the standardization of curriculum, thus emphasizing the role of the core curriculum versus individual choices.

The second element of schooling to be examined is the time units defined for learning. At present, they are standardized and accurately defined: A lesson (one or two hours), A Day (Four to six hours out of 24), a Semester (About three months out of twelve), A degree (Six, Twelve years at school, or three and five in higher education). As we can see, the standard time units are mechanically determined as physical units. They are unrelated to the nature of learning—the high standard deviation of the graduates at the end of each unit. The alternative is to allow for flexible time related to individual learning capacity rather than mechanically determined. At present, all educational technologies are confounded to the present boundaries of time units, and even the so-called individualized learning technologies obey the present system. The new trend in Higher education of dividing time units of learning into Micro credential units is done within the mechanical concept. The choice is clear; once again, the technology is directed to empower the factory concept of education.

The third element we want to explore is the curriculum. We have already explored the curriculum issue as a goal carrier; however, technologies have brought a meaningful change to the curriculum structure and organization by enriching the content presentation with sound visualization, enabling the organization of difficulty levels, and providing feedback to the individual learner. However, despite the innovative changes, the idea of the textbook is still conserved as the overall framework and obeys the crucial role of grading, mechanical time units, and the linearity of the production of proficiency; the case of the curriculum is

perhaps the best evidence for conservation, disguised by innovation.

The measurement of learning efficiency is the fourth element we want to explore. The mechanical concept of learning also defines measuring learning outcomes by a singular, linear yard stick. This is a very different approach from the complexity of the modern notion of understanding. The simplicity of the present viewing of learning outcomes ignores the complexity of learning outcomes as modern science defines them, and once again, the measurement technologies are still operating by conserving the present situation rather than confronting the complex nature of learning outcomes,

The last relevant element we want to explore is the learning spaces designed by architecture. The universal element of the learning space is the classroom. The classroom is the production unit of the factory schooling. A classical and universal classroom consists of a square space, 40/40m. Each grade has one or more classes per grade, and the layout of the classes is usually linear. In most of the so-called future schools, the classroom component still prevails. The availability of sophisticated design tools such as AutoCAD and Revit Design did not change the architecture of the learning spaces to allow for flexible and complex learning. So, we find that even creative architecture cannot, so far, induce meaningful innovation, and the classroom space unit has not been transformed.

CONCLUSION

In the beginning, we asked whether educational technologies catalyze innovation and change or empower conservation of the present system.

The makeup of the present schooling was established during the Industrial Revolution and, therefore, was inspired by Newtonian mechanical principles underlying the production complex. Thus, the basic design of a school is similar to a factory: the learner is like raw material, The grades are like a linear production line, Goals are standardized for all, and so are learning time units, the classroom is the production unit and the curriculum is compulsory for all, This kind of schooling was not tailored for living people that, unlike raw material, obey biological and social principles and not physical ones. An alternative schooling was suggested to serve the learning of living humans.

I have redefined technology, following Hildegard and Ellul, as the collective, creative intelligence of mankind, dedicated to solving human problems and providing for human needs. Technology itself has no goals. It is not an end by itself. The Inventor and the user define problems and the needs that require solutions. In our case, educational policymakers, school principals, and teachers must choose between two alternative models of schooling: Using technology for the present factory school model or using its alternative.

Analyzing step by step the choices made between the various elements of educational school models, the answer is clear cut. Believing that technology is an end by itself, the choice, because of multiple reasons for each element, was the factory model of schooling. The excellent technologies, from 3D printers to Generative AI algorithms, serve conservative systems rather than Innovation. It is conservation in the disguise of innovation.

The only way to change this situation is to recognize that we need to leave the tradition of the Industrial Revolution and choose alternative schooling that is transforming the perception of learners and learning from mechanical to humanistic. Only then will technology be able

to become disruptive and make the far-reaching transformation required for education to join the knowledge age.

REFERENCES

Chen D. (1992`). An epistemic analysis of the interaction between knowledge and educational technology. In Barret's edit. Sociomedia! 61-173. The MIT Press.McLuhan M., Powers B.P. (1987). The Global Village. Oxford University Press.

Buckland M. (2017). Information society. The MIT Press.

Chen D., Wattad G. (2023). The production and distribution of scientific knowledge. Journal of educational research and reviews. Vol11 (4) 68-73).

Heidegger M. (1977). The question concerning technology. Harper Torch Books.

Ellul J. (1964). The technological society. A Vintage Book.

Gardner H. (2004). Frames of mind: the theory of multiple Intelligence. Basic Books.

Pinker S. (2016). The blank slate: The modern denial of human nature. Penguin.

Sacks P. (1999)/ Standardized minds. Perseus Books

Skinner B.F. (1989). The origins of human thought. American Psychologist. 44. 13-17

Ackerman E. (2001). Piaget constructivism and Papert Constructionism: What's the difference? Future of learning group publications (3) 438.

Glaser R. (1978) Research development and school change. New York wily.

Chen D. (2010). Schooling as a knowledge system: Lessons from Cramim experimental school. Mind, Brain and education Vol4 (1) 8-19.

Book scouter (2024). The biggest educational publishers.

Assessment system corporation (2024) Online testing solutions, Adaptive testing.

Lang C. Wise F.A. Siemens E. (2017). Society of learning analytics resource.

Chen D. Arar K. (2021). Education in 2051: Knowledge technology to the rescue, adapting education means and ends to diverse learners. In: Papa R., Jackson K.M. editors. Artificial intelligence, Human agency and the education leader. P 161-164.