What Should the Future of Learning Look Like?

Looking Back, Looking Forward

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Received: February 11, 2022 Accepted: March 27, 2022 Online Published: March 31, 2022

doi:10.5430/ijhe.v11n5p51 URL: https://doi.org/10.5430/ijhe.v11n5p51

Study the past if you would divine the future.

—Confucius

Abstract

This paper explores a possible and desirable future of technology-enhanced teaching and learning in higher education. It takes a normative lens that defines what 'ought to be,' based on considerations grounded in the philosophy of education. In other words, its aim is more prescriptive than predictive. It will suggest we embrace technology only to the extent that it brings us closer to realizing the pedagogical ideals of educability, personalization, and active, experiential learning. This paper examines how these principles prove helpful in prioritizing the technologies worthy of being adopted and how technology can contribute in a meaningful way on all three fronts. In addition to the principles of pedagogical innovation, practical considerations for realizing the future state will be identified. In this context, it is argued that the envisioned future of technology-enhanced teaching and learning in higher education can come to fruition only when education becomes collaborative and course creation builds incrementally on previous educational iterations, made possible through institutional support and collaborative design.

Keywords: learning technologies, technology-enhanced learning, education futures, philosophy of education, Socratic method

1. Introduction

As he was supervising the creation of short educational movies in 1910 (Krows, 1939, p. 16), Thomas Edison likely thought back to the challenging few months he had experienced as an eight-year-old pupil in Reverend Engle's single-room school in Port Huron. He did not feel that he fit in, and he even overheard the schoolmaster say that his mind was "addled" (Josephson, 1959). Unsurprisingly, Edison had a profound distaste for the schooling he had received. Instead of rote learning, he preferred to observe with his own eyes, make things with his own hands, and do things by himself. Learning was for him a sensorimotor experience.

Although more sensory than motor, Edison thought that recorded sound and movies were better ways to satisfy the need for an authentic learning experience than traditional schooling. He believed that movies were better suited than books to bring to life historical events like the American Revolution, convey the workings and beauty of crystals, and reveal the microscopic life of ponds (Krows, 1939, p. 16). (Note 1) He claimed in an interview that movies make "the scientific truths, difficult to understand from textbooks, plain and clear to children" (Smith, 1913, p. 24). To 'prove' this, he had students watch educational movies and asked them to write down what they had learned. If they had not understood an aspect of the film, he simply repeated the viewing as often as needed until they did, wishing both books and teachers into obsolescence. Although steered by ideals of efficiency and scientificity, his views on education seem to have only a veneer of scientific validity. Peppering arguments with pseudostatistical data, he claimed that "85 percent of all knowledge is received through the eyes and that motion pictures are 100 percent efficient for its dissemination" (Associated Press, 1923, p. 2), compared to a mere two percent efficiency provided by schoolbooks (King, 1999, p. 211; Cuban, 1986, p. 9).

From the 1913 interview, many commentators will cite his famous prediction that, within ten years, "books will soon be obsolete in the public schools. Scholars will be instructed through the eye." They will use this quote as a cautionary tale to confidently predict that technology, although repeatedly hailed as a soon-to-be disrupter of education, is not the future of education, just as laptops did not overtake classrooms in the 1990s and massive open online courses (MOOCs) did not disrupt universities in the 2010s, contrary to predictions at the time. While not entirely untrue, this interpretation misses the mark like most long-term predictions. This view does not take into consideration people's propensity for hyperbolic rhetoric. Edison is no exception and often displayed a used car salesman attitude—after all, he was just as much a businessman as an inventor trying to boost sales for his inventions. In 1877, when he invented the phonograph, he enthusiastically 'predicted' that his invention would lead to radical changes: "the lecturer will no longer require his audience to meet him in a public hall, but will sell his lectures in quart bottle, at fifty cents each," (Taylor et al., 2012, p. 38). In a rather fanciful way, he declared: "though students in college may be required to learn the use of books, just as they now learn the dead languages, they will not be expected to make any practical use of the study. Blessed will be the lot of the small boy of the future. He will never have to learn his letters or to wrestle with the spelling-book" (Taylor et al., 2012, p. 39).

Such statements from Edison were rarely taken seriously by educators, so invoking them could be something of a straw man. (Note 2) More generally, it is not interesting nor fruitful to presume that all new educational technology is hyped and deterministically leads to a "trough of disillusionment," proving it has little to no impact on education (Cuban, 1986). It seems more productive to separate the embellishments from the nuggets of truth. In the end—hype notwithstanding—multimedia, computers, and MOOC-like material are indeed playing a significant role in educational settings today, each representing an impactful new addition to the arsenal of helpful learning materials and methodologies. Although few would expect a technotopian takeover, it is reasonable to expect that innovative technology will continue to be instrumental in shaping the future of education. The critical question here is to understand which technologies we should embrace and promote in an educational context and which are likely to be successful in the future, while avoiding shiny new gadgetry. To do this successfully, we must ensure that technology adoption is rooted in pedagogical principles.

This paper explores a possible and desirable future of teaching and learning in higher education that embraces technological and pedagogical innovation. This is a narrow field of exploration, not only because of the self-imposed sector restriction, but also because the intention is to omit broader questions about the finality of education, its influence from and on society and culture, the 'systems' of higher education institutions, and the contents of teaching and learning. Although broad enough, the experience of teaching and learning will be the sole focus of attention. Note also that this will not be an exercise in futurology and does not claim to have any predictive validity based on current trends and analytical methods. (Note 3) Instead, it takes a normative lens that defines what 'ought to be,' based on considerations grounded in the philosophy of education. In other words, its aim is more prescriptive than prospective. I will suggest we embrace technology only to the extent that it brings us closer to realizing certain pedagogical ideals, not because it proves efficient or 'scientific,' with all due respect to Edison. However, the approach will not fall into utopianism either, as the ideal will be differentiated from the idealistic by considering the pragmatic realities that both limit and make possible a future state.

2. Back to Plato

When we consider the future of learning from a normative and teleological perspective (i.e., from the question of what we should be aiming for), we presuppose an ideal state toward which all efforts should converge, knowing at the same time that, by definition, this state can never be fully achieved. If it could, it would not be an ideal, but rather an optimum. Similarly, 'ideal' does not suggest in this context the connotation of 'timeless perfection,' but rather 'belonging to the realm of ideas,' that is, constructs emphasizing desirable features. Weberian ideal types or archetypes can be valuable heuristics and guide our efforts toward a desirable future state (Weber, 2017, p. 90).

We can begin by asking, what would an ideal learning situation look like? How would we start defining such a thing? Learning has a clear anthropological foundation. People do not learn in a fundamentally different way today than they did 2,000 years ago. In ancient times, civilizations built temples, conducted warfare, governed polities, and created poetry and art based on prior learning with the same level of finesse as today. Learning as a deep-rooted human faculty did not 'evolve' through the millennia, just as one would not claim that Shakespeare's tragedies represent an evolution over Sophocles'. Where evolution did occur is in the body of knowledge—of technical knowledge in particular—rather than in the faculty of learning. Learning is a feature of being human, a trait we share, to a different extent, with animals. It is an act of spontaneity; we do not 'decide' to learn, although we can orient, inform, and facilitate learning. Because normative frameworks are unbound by time, ideal learning applies to past as well as contemporary contexts. It so happens that ideal learning was defined long ago and has enjoyed widespread recognition through the ages. If this is true, we can, paradoxically, learn about the future of learning by looking back into the past. It also means that we can define the ideal learning situation with some degree of consensus, or with as much certainty as is possible in any human affair.

Ideal learning is embodied in a classic text in the history and philosophy of education. In Plato's *Meno*, Socrates seeks to show that we can learn without direct instructions by drawing from innate faculties through a process of anamnesis, by way of calling back to mind knowledge that already sits within us. On this assumption, learning is a property of the learner rather than a function of the teacher, and that is why Socrates expressly urges his listeners to move away from the notion that learning is imparted as the result of passively listening to a teacher.

To demonstrate this, Socrates undertakes to draw out advanced geometry knowledge from someone with no prior education, just as a midwife helps to deliver babies. (Note 4) Commentators often refer to this famous scene from the *Meno* as the "slave boy experiment." The geometry problem is about how to determine twice the area of a square, keeping in mind that doubling the sides of a square quadruples the area. Below is an abridged version of how Socrates brings about active learning from the slave boy while refraining to simply impart knowledge by telling him how to resolve the puzzle (Meno, 82b–85d). From this depiction, we will be able to extract a few principles inherent to the ideal learning situation.

Socrates: Fetch any one of your servants. This one, is he a Greek and does he speak Greek?

Meno: Yes

Socrates draws a square in the sand and turns to the boy.

Socrates: You recognize a square, don't you? It has four equal lines.

The boy nods. Socrates draws two additional lines from the middle of each side, dividing the square into four smaller squares of equal size.

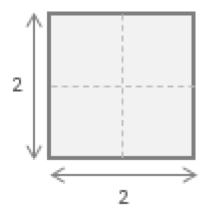

Figure 1.

Socrates: Now, if one side is two feet and the other is two, the whole area would be twice the size, right? How much is twice two feet?

Boy: Four.

Socrates: Good. Let's say we double the length of the sides; how large would the area be?

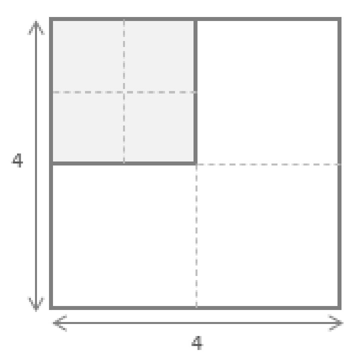

Figure 2.

Boy: Eight.

Socrates: Hmmm . . . not quite. How long would each side be? The original square is two feet long. How long is the side of the second square, which is double the first in size?

Boy: Four.

Socrates: From a square with sides of four and four, you said there would be an eight-foot area. But isn't it double that size?

Boy: It is indeed four times the size of the original square. Now I see!

Socrates: What is four times four?

Boy: Sixteen.

Socrates: Good. Now, based on this four-by-four square, what would be the length of the sides that would cover eight square feet? As you were saying, a square of two-by-two feet is four square feet; a square of four-by-four feet is 16 square feet. That means that a square of eight square feet must have sides that are longer than two but less than four, right? How long would the sides be?

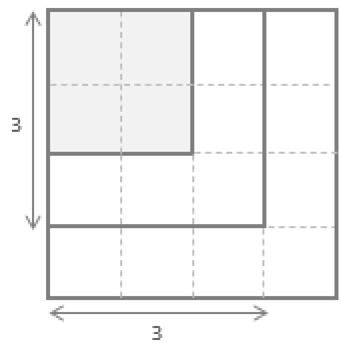

Figure 3.

Boy: Three feet.

Socrates: Now, three feet by three feet on each side would make for a square of which size?

Boy: Nine.

Socrates: That's not the eight feet we were aiming for, is it?

Boy: I am at a loss . . .

Puzzled, the boy scratches his head. Socrates turns to Meno.

Socrates: As you can see, Meno, at first, the boy thought he knew the answer, even showing confidence, but he didn't really know. Putting him in difficulty jolted him. Now, he doesn't know but is eager to, whereas previously, he thought he knew, which gave him no reason to enquire any further. Now, we can pursue our joint enquiry.

Socrates turns back to the boy.

From the large four-by-four square divided into four equal two-by-two smaller squares, he draws a line that dissects the smaller squares in two with four diagonal lines that together form a new square tilted at 45 degrees within the large square.

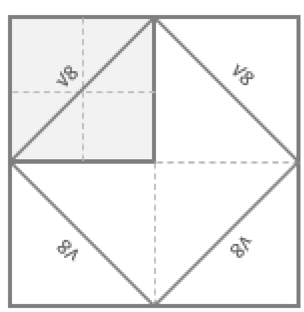

Figure 4.

Socrates: Now, these diagonal lines are cutting in half each of the small squares making up the large square. The diagonal lines form a new tilted square. How large is this area?

Boy: I don't think I understand . . .

Socrates: There are four small squares, and each diagonal line has divided each small square in half. How big is the large square comprising the four small squares?

Boy: Sixteen.

Socrates: And if every small square of two by two is divided in two by the diagonals, how large is the new square formed from all four diagonals?

Boy: The small squares are four square feet. Divided in two, the area is two square feet. Four times this area of two square feet makes eight.

Socrates: Good. So, where does the eight-foot square come from?

Boy: It comes from the diagonal that divides the small squares in two.

Socrates turns to Meno.

Socrates: So, Meno. Do you think the boy gave any answer that was not his own belief?

Meno: They were all his own. Yet, he didn't know at first, but these thoughts were stirred up in him through a series of questions.

Socrates: Yes. He pulled the knowledge out of himself, guided by my questions.

Generations of scholars and pedagogues across the centuries have invoked the Socratic method of question and answer as a central tenet of authentic learning. (Note 5) In many ways, the Socratic method feels modern and relevant to the present-day educational context: knowledge is not seen as an object gifted to a student, as if filling a vessel, but instead actively and dialogically constructed by the learner under the guidance of an instructor.

Because *Meno* employs a dramatic rather than a theoretical framework, it does not present an explicit education theory. It is up to the reader to translate representation into concept and elicit a formal pedagogy, certainly leaving much room for interpretation. Arguably, the slave boy scene can be interpreted as a process of learning consisting in a gradual ascent from lower rudimentary elements to the higher ideas of things, a common metaphor for learning and knowledge in Plato and Neoplatonism. The first level is the reliance on a common language (recall Plato's initial question, "does he speak Greek?") and culture ("is he Greek?"), on the basis of which, at a second level, background knowledge can be brought to the fore. At a third level, false preconceptions are corrected and adjusted to establish facts. Once these facts are secured, the learner is ready to actively manipulate facts through representation and imagination, as supported by the drawings in the sand. From this fourth level, learners reach the higher plane of ideas when they understand the concepts rather than seeing their representation in mere images. In the same way that the empirical representation of geometrical figures does not have the same properties as their related concepts (e.g., a line drawn in a notebook has two dimensions, whereas a geometrical line only has one), the imperfect sand drawings are anchors that help the learner reach the level of ideas and concepts (referred to as "Forms" in Platonism).

However, of interest in the context of this paper is not the mechanics of learning described in this gradual ascent to knowledge but the normative principles that define the finalities of teaching and learning and can serve as criteria for pedagogical innovation. The following section will explore these principles based on the Socratic scene above.

3. Principles of the Ideal Learning Situation

Meno's slave experiment reveals three principles of learning that can help define the ideal learning situation and the aspirational goal of pedagogical innovation.

3.1 Educability (or Learning Is Universal)

When Socrates asks Meno to "fetch any one of [his] servants," he suggests that learning of any matter, including advanced geometrical knowledge, is open to all, no matter their social standing or prior education. He is being deliberately provocative when calling on the slave to illustrate his point, as slaves were illiterate in ancient Greece (contrary to ancient Rome), and theoretical mathematics was an elitist pastime enjoyed only by "the upper circles of Athenian society" (Asper, 2009, p. 123).

Socrates believed in the universal educability of all humans. Undoubtedly, he had not put this belief to the test and was certainly aware that not all individuals were de facto equally capable of learning complex matters, so what should we understand under the universality of human educability?

This notion is premised on the conception of humans as potentiality—or a sum of possibilities—spurred toward complete actuality (also known as entelechy), an idea that is echoed in the human-potential model of education derived from humanistic psychology. Evidently, it has an anthropological foundation, setting educability as a defining feature of human beings. This view has been a common thread since the Enlightenment. According to French philosopher Jean-Jacques Rousseau, for instance, the defining characteristics of humans—perfectibility, freedom, and inherent goodness—are also the principles that he sets forward to define a philosophy of education. Being governed by instincts, animals have no freedom to reinvent their behaviours and improve on, or perfect them, over time. The bees' dance described by Aristotle in the fourth century BC is the same as the one described by Von Frisch in the early 20th century (Heidborn & Munz, 2010). Humans, by contrast, can constantly transform themselves for the better through education. (Note 6) And because of children's inherent goodness, typically corrupted by the influence of society, Rousseau advocates for a child-centred education that supports the development of the pupil's natural capacities through a process of autonomous discovery (Bertram, 2020), (Note 7) learning through experience and active participation (more on these themes below). (Note 8) If this is reminiscent of Socrates, it is perhaps because Rousseau was an avid reader of Plato, whom he often cited in *Emile* and other works.

The Enlightenment's concept of perfectibility is closely related to the idea of educability. Humans are perfectible only to the extent that they are educatable. In the early 19th century, inspired by Enlightenment thought, deaf education pioneer Jean Itard stated that "deaf-mute [sic] are no less perfectible than other people" (Itard, 1821, p. 445). He adopted a similar view when a feral child (diagnosed in retrospect as autistic) was entrusted to his care. He believed in the fundamental educability of human beings who had not been given similar learning conditions as others.

However, educability is more than an anthropological concept that defines humans. According to Philippe Meirieu, a contemporary French educational thinker, it also serves a methodological function (Meirieu, 2009). At a first level, it is a logical principle inherent in any educational activity, as no one would bother educating students if they were not deemed educable in the first place (Meirieu, 2016). More importantly, especially in terms of pedagogical innovation, it is a heuristic principle that pushes the educator constantly to think of new ways to facilitate learning, even among those commonly deemed uneducable (Meirieu, 2009). The innovative potential of this concept cannot be overstated, considering that, according to Meirieu, it provides the impetus behind the progress of most pedagogical processes. Finally, educability is also an ethical and political principle based on a commitment to the fundamental equality and dignity of all. In this context, not believing in the learner's potential is a lost opportunity and an ethical failure. From an anthropological reality, it becomes a right—the right to realize our potential and become the best version of ourselves. If realizing our potentialities, according to Aristotle, (Note 9) is the condition for happiness and the good life, education becomes a crucial tool for happiness, (Note 10) the realization of which has inherent ethical value. The principle of educability then translates into a commitment to reject elitist beliefs in social or genetic determinism that could impede the learner's access to education. With this principle in hand, educators promote access and success of the greatest possible number of learners instead of uncritically accepting the survival of the fittest. In this context, learning is postulated as universal.

So, in the end, it matters little if the concept of educability or the universality of learning is factually true, as it is beneficial and just, when functioning as a heuristic and ethical tool for the betterment of education and people. Meirieu puts it thus: "This is why I recognized this commitment to educability as, most likely, scientifically false—although we do not know for sure—but ethically just and necessary, as it is a commitment to humans. Equally, I recognized its heuristic scope: it is because of this commitment that we set forth and invent pedagogical means to help others to learn and grow." (Note 11) This is the lens from which MOOCs should be viewed. Pointing to the failures of MOOCs misses the big picture if it does not also capture how they represent a commitment to the universality of learning. That said, the practical applications of this principle will be explored in the next section of this paper.

3.2 Personalization (or Learning Is about Personal Needs and Interests)

Intuitively, we can recognize the one-on-one training depicted in the slave boy experiment as an ideal learning situation. Tutoring allows for the highest level of personalization by adapting the learning situation—pace, progression, content, contact time, learning preference, and immediate feedback—to an individual learner. Whereas the first principle of ideal learning considers the learner as a general entity, personalization considers their individuality.

Numerous studies have consistently confirmed the benefits of tutoring and similar approaches (Nickow et al., 2020), including for students from disadvantaged backgrounds. The question is how to recreate this one-to-one relationship in the more usual context of group learning following the massification and democratization of higher education.

This happens to be the question the famous educational psychologist Benjamin Bloom explored under the '2-sigma problem' (Bloom, 1984). Bloom compared three types of teaching: (a) conventional, where students learn in class and take summative tests; (b) master learning (ML), where students take formative tests, followed by feedback and corrective activities to ensure subject mastery; and (c) tutoring, which consists of ML within a one-to-one setting. Bloom discovered that students' average grade under ML was around one standard deviation above the average in a conventional class, whereas tutored students scored around two standard deviations above the conventional class. He also noted similar improvements in students' time on task and attitudes (e.g., positive academic self-concept) and interests (e.g., a greater interest in the subject and a greater desire to learn more in the subject field), as well as a reduction in correlation between prior aptitudes and achievements in summative assessments.

Bloom understood that one-on-one tutoring was not a scalable solution in the context of mass education. However, he was committed to improving group teaching to, or near, the levels achieved under tutoring. In other words, he sought to increase learning performance by two standard deviations. As the symbol for standard deviation is σ (the Greek letter sigma), he referred to this goal as the "2-sigma solution." The following research question guided his efforts: "Can researchers and teachers devise teaching-learning conditions that will enable the majority of students under group instruction to attain levels of achievement that can at present be reached only under good tutoring conditions?" (Bloom, 1984, p. 4).

In response to this question, he identified several alterable educational variables, including the ML feedback-corrective approach, students' initial cognitive entry prerequisites, organizational aids, home environment, and peer groups. While separate manipulation of dependent variables did not have an effect size of two sigmas, the combination of variables did approach two sigmas. He achieved his best results in two ways: by combining (a) ML with enhanced prerequisites (e.g., a boot camp course before the start of the semester), which improved the experimental group to 1.6 sigmas above the control group on the summative assessment; and (b) ML with enhanced explanations, participation, and reinforcement, which improved results to 1.7 sigmas. These were significant improvements approximating the 2-sigma goal.

Although subsequent research has not confirmed the quantitative improvement measured by Bloom (Ricón, 2019), an innovation-focused educational goal has been clearly defined. Bloom has set a fruitful challenge for educators: how do we approximate the tutor-learner setting (including feedback and corrective activities) and personalize the learning situation to best adapt to students' needs, strengths, weaknesses, and interests? Bloom had already intuited the role technology could play in this context in the early 1980s. At the time, the only example available to him was the PLATO learning platform (Dear, 2017), but he believed it to be a promising avenue.

3.3 Agency (or Learning Is Active and Experiential)

A third principle of learning inferred from the slave boy experiment is that learning is, in essence, active. It involves the full participation of the learner rather than passive listening to a lecture. In its most basic form, the third principle is exemplified by the notion of 'learning by doing,' (Note 12) whereby students are actively engaged in learning 'experiences.' It is more generally reflected in the concepts of experiential education and active learning, and it is typically associated with the apocryphal quote from Socrates that "education is not the filling of a vessel, but the kindling of a flame," (Note 13) which pithily conveys the idea that learning is not about being taught—in passive voice—but implies motivation to act.

The evidence supporting experiential education is substantial and conclusive. (Note 14) That said, why is it that experiential learning improves the acquisition of knowledge, skills, and attitude and the overall growth of the learner? According to the pragmatism school of thought, knowledge and understanding are inherently grounded in actions and experiences rather than being a disinterested and disengaged contemplation of the world. At a semantic level, for instance, we understand the meaning of words and concepts when we know how to use them in context. At an epistemological level (i.e., defining the nature of knowledge), pragmatists describe how knowledge results from enquiry and experimenting, in which we change reality in specific ways. We actively engage with the world and manipulate it to see what happens. We know something to be true—and acquire knowledge—only after testing it. For instance, we know that the water is cold after dipping a toe in it, that is, after manipulating reality in such a way as to experience the coldness of the water. Of course, more complex knowledge requires more complex experimentation. Rather than a spectator to the world, the knowing subject is an agent that constructs knowledge. Fundamentally, knowing is doing something to the world.

The pragmatists' view applies not only to knowledge but also to values and unknowable beliefs. For instance, we adhere to democratic values because they produce the results we are looking for, such as happiness or utility. If our view has no practical impact compared to someone else's, it is a pointless object of debate for pragmatists. What counts is not what truly is (in what is called the 'noumenal' world beyond experience), as foundationalist philosophers would believe, but rather what has a bearing on what we do and experience.

This theory is the background from which John Dewey, the famous educational philosopher and pragmatist, developed his thoughts on education. For him, learning happens in personal experiences where the learner grows and actualizes potentialities and capabilities that were previously latent (Dewey, 1938). Not all experiences are fruitful. Some are "non-educative" or, worse still, "mis-educative," to use terms from Dewey's repertoire. And that is why the educator has a responsibility toward the learner to select and craft quality experiences conducive to learning.

That said, what defines a quality experience? According to Dewey, a key criterion of educational experience is creating growth now and in the future (which he referred to as "continued growth"). In other words, a fruitful and expansive experience that creates conditions for further growth—one that "open[s] up avenues for development in other lines" (Dewey, 1938)—will be educative. In contrast, an experience that stunts future growth in new directions will be mis-educative. "Growth" applies both to personal development and to the learner's world, which expands with every new experience and learning. For instance, learning to read develops a new capability while also opening a host of new areas of knowledge and growth that learners can further explore in the future. The same thing could be said for creating attitudes that kindle a love of learning, curiosity, or creativity. Conversely, experiences in which an individual receives excessive criticism for failures may undermine self-confidence, closing avenues for future learning.

Finally, there is freedom in the process of learning through experience. This freedom does not negate the educator's responsibility to frame and shape favourable experiences or the reality of having to follow rules. Games can help illustrate this point. Games have rules freely acknowledged and followed by the players. Breaking the rules leads to a breakdown of the game itself, whereas disputes usually result from a perceived violation of, rather than a challenge against, the rules. Games involve sharing in a common experience governed by rules that are not determined by individuals but rather by the group. For Dewey, learning is of this social nature. It involves freedom for the learner to contribute and feel responsibility in the learning process where rules, although set externally from the individual, are freely adhered to. In this context, learning is perceived as a social phenomenon involving the learner, colearners, the teacher, and others in creating educative experiences.

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These are the three principles of the ideal learning situation one can draw from the slave boy experiment. The goal is not to be exhaustive and draw all possible conclusions from it but to set the table for a fruitful exploration of what an innovative future should hold for higher education.

To be sure, there are glaring blind spots in the narrow representation of the ideal learning situation derived from the Socratic scene. For instance, it is not clear whether the learner would participate in the learning experience if they were not compelled to do so by an authority figure. Why at all bother with learning? What sparks the motivation to learn in the first place? Equally, in the Socratic scene, the content of learning is predetermined by Socrates, leaving open such questions as: what should be learned? and to what extent should the learner be involved in learning goals? While these questions have an answer in Dewey's experiential approach, they are obscured in the Socratic scene. Finally, the presupposition seems to be that the teacher-midwife is all-knowing and can alone meet the learner's educational needs. Of course, this is a dubious assumption at best.

Nonetheless, we will stand on a more solid normative ground to define an innovative future of teaching and learning in higher education with these three principles in hand.

4. Possible Futures of Teaching and Learning Based on the Idea of Pedagogical Innovation

Following the reasoning of the previous section, if our goal is pedagogical innovation, we should look at different permutations that would bolster access, personalization, and fruitful experiences for learners. By the same token, we should better understand why many past attempts to innovate have not always proven fruitful.

For instance, Skinner's efforts toward a "technology of teaching" (Skinner, 2003) were not aimed primarily at educability, personalization, and agency, but rather—as with Edison—at productivity and efficiency. "Education must become more efficient," he claimed unequivocally (Skinner, 2003, p. 47). His goal was primarily to "[save] resources and the time and effort of teachers and students" (Skinner, 1977, p. xii), foremost through mechanical means. That said, he did incidentally stumble upon the three principles of pedagogical innovation. He believed that increased productivity, most efficiently through technology, would lead to greater access: "[A technology of teaching] permits [the teacher] to teach more—more of a given subject, in more subjects, and to more students" (Skinner, 2003, p. 235). He was strongly averse to negative reinforcement, much preferring the positive feedback stemming from the successful manipulation of the learner's environment. Learning was to be an active undertaking rather than passive assimilation of knowledge. This view certainly aligns with the principle of agency. Moreover, one of his biggest gripes against classroom teaching was the lack of immediate feedback (or, in his parlance, "reinforcements"), given that an instructor typically attends to 30 or so students. Immediate and appropriate feedback is undoubtedly an essential ingredient of personalization. (Note 15)

However, his insistence on productivity and control made him focus on technology and the mechanically improvable aspects of access, personalization, and agency in such a way as to reduce impact. This reductionist approach is best exemplified by Skinner's teaching machine, which he views not merely as a useful but also as a required tool in the modern classroom: "If the teacher is to take advantage of recent advances in the study of learning, she must have the help of mechanical devices," which alone can provide "the most effective control of human learning" (Skinner, 2003). (Note 16) While Skinner's teaching machine allows for self-paced learning and provides for some personalization and agency, it does so at a basic level, limited as it is by the few options provided for by the initial instructional program and the device's affordances. The learning experience provided by the learning machine is worlds away from the expansive experiences envisaged by the pragmatist and humanist educators. It makes no provision for students' learning styles and personal interests. And it is hard to see how this type of mechanical learning can generate attitudes that kindle a love of learning, curiosity, and creativity, not least because it turns learning into a solitary experience.

That said, the techniques involved in Skinner's teaching machine are not without merit. They often form the basis of many automated and adaptive learning materials in current online courses—to the extent that they align with the principles of pedagogical innovation. Their modest relevance in instructional design becomes more apparent once the principle of efficiency is removed from its position of preeminence and the techniques are put fully in service of the three guiding principles. In fact, it is reasonable to believe that the richness of computer-assisted and adaptive learning can take programmed instruction to the next level and better fulfill Skinner's educational dream if guided by the principles of pedagogical innovation.

Education sciences have developed many methods and practices for fulfilling the three principles. Let us consider how they can be integrated into a vision for the future of teaching and learning in higher education, with special attention to the role of learning technologies.

4.1 Universalization of Education

In a future state, access and educability will be built into the very design of courses and learning environments. In this context, technology-enhanced learning will play an instrumental role in effecting meaningful change (although not all universalization efforts will be technology-based). To better illustrate this, we should consider two inclusion frameworks: equity, diversity, and inclusion (EDI) in teaching and learning (T&L) and Universal Design for Learning (UDL).

Rather than a formal method, EDI in T&L is a critical stance that promotes attitudinal and behavioural change in students and teachers. It aims to increase awareness and self-criticism of personal, often unconscious, biases. It raises issues of systemic inequity and oppression, privilege, safe spaces, labelling, and naming. In an EDI in T&L context, success is achieved when teachers and learners are sparked to create new habits of mind and, ultimately, engage in social action in the spirit of social justice (Burrell, 2020). An EDI lens aligns with the principle of educability, as it aims to "harness diversity, create fairness and ensure our learning environments engage and achieve the best outcomes for all individuals, not just a few" (OECD, 2014, p. 9). Other earlier educational approaches have been, over time, assimilated in whole or in part within the EDI perspective, such as multicultural education, inclusive teaching, and the movement to decolonize curricula and indigenize learning. Other approaches overlap with it, such as internationalization and global education, which raise similar themes, such as intercultural skills, creating safe and inclusive spaces, and decolonization.

Technology's role in cementing an EDI perspective in education is growing in lockstep with learning analytics (LA) and artificial intelligence in education (AIEd). LA and AIEd are finding applications in learner profiles and attribute assignment, predictive modelling of student outcomes, teachable agents (virtual assistants), assessment and adaptive learning, and diagnostics of student engagement, to name a few examples (Zhang, 2021; Gocen & Aydemir, 2021; Chen et al., 2020; Yang, 2021). Already, the use of LA and AIEd is closing achievement gaps and improving retention rates with disenfranchised groups, thus broadening success as well as access (Bannan, 2019). In parallel, awareness about biases built into algorithms and attribute selection, such as in LA learner profiles, is increasing, as are the efforts to take an EDI perspective to correct these biases (Huang et al., 2020). In this effort, new areas of study are emerging, such as critical data studies (Selwyn, 2020), postcolonial computing (Lazem et al., 2021), and other approaches based on taking an EDI lens to computing issues, for instance critical race theory for human–computer interaction (Ogbonnaya-Ogburu, 2020).

While these advances are mainly confined to experts outside the classroom, LA and AIEd also find applications within the classroom setting. For instance, digital teaching simulations are used to promote EDI behaviours in a measurable way (Littenberg-Tobias et al., 2021). Technology enhancements also seem promising in global education, as this area benefits from the digital environment in the "technology-supported internationalization" trend (Mittelmeier et al., 2021). With the help of technology, students can enjoy the benefits of internationalization without having to leave home.

In a future state, LA and AIEd applications will integrate EDI principles at the application design stage. Teachers and learners will have access to EDI-informed applications, EDI-promoting simulations, and internationalization programs accessible to students who do not have the means to travel.

UDL is another prime example of how technology can contribute to universalization and educability within the classroom. It has its roots in industrial and architectural design and was initially intended to improve physical access to products, services, and environments for people with disabilities. The design principles proved relevant to many situations, including learning, where access and usability were to be expanded for the greatest possible number of people. UDL intends to break down barriers to learning and accommodate all types of learners with divergent backgrounds, needs, and interests (Rose & Meyer, 2002). It does so by providing flexibility in three modes that correspond to the "what," "how," and "why" of learning. More specifically, the goal is to provide multiple means of (a) representation—the learning content is shown in several ways through multiple media; (b) action and expression—learners demonstrate knowledge acquisition in several ways; and (c) engagement—learners' interest and motivation are sustained in several ways (CAST, 2018). Although technology is not an indispensable aspect of UDL, it does increase options for greater flexibility and customization at the heart of UDL (Rose et al., 2012).

In a future state, all courses will offer "multiple coding," where content is presented in multiple modes such as written, audio, image-based, and video material, with permutations being guided by the content itself. They will provide various assessment options such as tests and quizzes, forum postings, interactive online assignments, and collaborative assessments, either on paper, video, or via other web-based forms. Technology-facilitated peer assessment will also be available where appropriate. Finally, courses will be constructed in such a way as to adapt to previous knowledge and learners' interests (more on this in the following paragraphs). A technology-enhanced course makes this all possible where time and expertise are available.

4.2 Personalization

There is a broad literature on personalizing learning from which various techniques can be drawn in a future state. To approximate the tutoring conditions as much as possible in a future state, personalization and immediate feedback would be applied at distinct levels.

At an institutional level, learner profiles would be created for program and career suggestions. The profiles would be linked to recommender systems and a virtual student assistant, helping to create communities of learning and a sense of belonging among students, linking individual students to one another, and suggesting on- and off-campus events that strengthen interpersonal ties and meet personal interests. Within graduate attributes endorsed by the institution, students would forge their own path and focus on what they find meaningful for their studies. In that context, they would be able to choose courses not only based on a disciplinary or thematic basis, but also on a competency basis (whether in communication or collaborative, creative, or other skills). Finally, the institution would provide a self-organized next-generation digital learning environment (DLE) for students to supplement a course-based learning management system (LMS) with a global cross-program and cross-course view of the student's learning environment, including collaborative tools, learning plugins, content creation, curation, and sharing (Koh, 2020).

At a program level, students would receive suggestions for learning paths that they could track from the DLE as they progress, with the possibility of exploring and creating alternative learning paths. This implies flexibility in the curriculum, including self-directed learning based on clearly defined learning outcomes.

At a course level, instructional design would be adapted to individual learner characteristics by adjusting the mode, content, and pace of instruction (Tetzlaff, 2020). An initial assessment would establish a baseline for relevant elements taken into consideration for change—for instance, prior knowledge (which would adapt course content), interests (content), abilities (mode), and learning preferences (mode and content). Ongoing data collection on skills and knowledge attainment would inform competency-based progression (pace and content), and nudge technology would ensure that significant course milestones are not overlooked (pace). In the end, most courses would adopt adaptive learning technologies, including artificial intelligence (AI) and cognitive systems. AI has additional advantages, such as improving individualized feedback based on students' cognitive state and emotions (Capuano & Caballe, 2020) and predicting learning outcomes, which provides an opportunity for institutional student support services to get involved when required. AIEd is a whole education science subdomain that has been active for at least a decade and promises a level of personalization that may someday surpass human capacity (Luckin et al., 2016).

Studies and meta-analyses have confirmed that, although the best human tutors outperform the best software-based tutoring systems (Ricón, 2019; Alkhatlan & Kalita, 2018), the latter is as good as the former on average (Ricón, 2019; Ma et al., 2014; Kulik & Fletcher, 2016; Fletcher, 2018). These findings give hope that we will soon approximate tutoring conditions in group teaching.

4.3 Active and Experiential

The benefits of experiential learning are well documented. If they are not widely put into practice in higher education today, it is less because instructors stubbornly want to hold on to entrenched modes of teaching than because of practical obstacles. Aside from practical reasons (e.g., resources needed or student-side limitations such as finances and conflicts of commitment and culture), rich experiential learning is not easy to apply systematically in all disciplines, especially in less practical subjects such as history or philosophy, although some areas of these disciplines can lend themselves to limited real-life application (e.g., living history or applied philosophy). Certainly, it is also legitimate in these disciplines to work through intricate passages from seminal works and adopt a purely intellectual approach. However, in this reflection on the future of teaching and learning in higher education, I would like to focus on how experiential learning can be broadened, especially through technological means. Improving ways to be more active rather than receptive in a learning context is always a valid pursuit, no matter the disciplinary field.

In a future state of teaching and learning, we envisage a greater use of tech-based gaming, digital role-playing, and simulation beyond STEM education or business and economics, with clear improvement in terms of motivation (Carrión & Colmenero, 2022), engagement, collaboration, cooperation, and communication (Mercer et al., 2021). Gaming will be used for cooperative learning and trust-, empathy-, and community-building (Lyons, 2022). Rich simulations will be leveraged to improve empathy (e.g., refugee experiences and poverty experiences; Hernández-Ramos et al., 2019; Killam et al., 2022), interpersonal and communication skills (e.g., conflict resolution and interviewing; Dorn et al., 2020; Rouleau et al. 2020), collaboration, situational problem-solving and decision-making, functional expertise training, and much more. Virtual reality (VR), mixed reality (MR) and 360-degree video experiences will supplement real-life experiences such as virtual field trips (Mercer et al., 2021; Pennisi, 2020) and all kinds of visualization (e.g., visualizing ancient civilizations and mythologies; Remolar & Fernández-Moyano, 2021; Fleury & Madeleine, 2012). Books will come to life through augmented reality (AR), with videos and 3D models popping off the page (Castellanos & Pérez, 2017; Rojas-Contreras et al., 2020) and allowing for a more interactive experience (Bacca et al., 2014).

Many such digital simulations and extended reality (XR) resources exist and are freely available in many forms (e.g., shared environments that are interactive and AI-based, ranging from simple to complex). However, they will become more widespread as low- and no-code development platforms become simpler to use. Engaging and motivating learning tools that offer immediate feedback will be accessible to instructors who want to take their teaching to the next level.

In the future state, not all courses will have an experiential design. However, a broader range of courses will integrate experiential learning through technology.

5. Realizing the Future of Higher Education

The normative approach we took leads to more practical considerations, to the extent that 'ought implies can.' Utopic ideals make for poor aspirational goals. The question, then, becomes how to bridge the aspirational gap. The future classroom imagined above is a tall order. Is it a bridge too far?

I believe three interwoven paths lead to our goal: open education, collaborative course development, and institutional support. They are variations on the idea that teaching, just as much as learning, should not be conceived as a solitary pursuit. As we can learn from Dewey, the social nature of learning involves many stakeholders. The educational setting is growing in complexity, with changing student expectations, social conditions, ethical views, digital culture, and multilevel diversity. Alone this complexity could have justified a call for collaborative teaching and course development. This approach is even more justified in a context where meeting the ideals of the future of teaching and learning in higher education can hardly be shouldered by a single heroic teacher. Notable human accomplishments are rarely achieved by isolated individuals and more likely rest on successive teams building on prior achievements and knowledge. Currently, new instructors are constantly recreating courses from the ground up, like Penelope endlessly weaving the same shroud that is undone every night. Substantial progress could be achieved if efforts were focused on incremental improvement and augmentation of existing work. Moreover, it is unlikely that any single person would combine all skills and knowledge required to develop the many features of the ideal course or be able to keep up with best practices and trends in educational design while remaining active in their research. (Note 17) If there were such unicorns, they would unlikely have enough time on their hands to deliver on pedagogical innovation. Finally, because time constraints are equally distributed among faculty members, it makes sense to involve professional services supported by the institution when developing a collaborative framework for teaching and learning.

So, it takes a village—or a well-composed team, ideally comprising the following members:

- Professor acting as a subject specialist and course sponsor
- Project coordinator
- Teams of subject matter experts (as required)
- Instructional designer responsible for course design (including user interface [UI] design), interactivity, engagement strategies, and integration of technology into pedagogy (Xie, 2021)
- Educational developer responsible for pedagogies, course structures, learning strategies, learning outcomes, learning activities, assessments, and other related topics (some overlap with the instructional designer) (Note 18)
- Learning technologist responsible for learning tools and platforms and various learning technologies (e.g., lecture capture, videoconferencing, and classroom response systems)
- Graphic designer and video artist
- Programmer (as required, depending on the level of complexity)

One can imagine the result: proper adaptive courses with multiple learning paths; multimodal media (in some cases VR or quality videos), gaming, and other engaging content; learning analytics providing insight into student success; the systematic application of UDL; and so on. Over the years, a dedicated team could create and maintain most first- and second-year courses at a midsized university.

Currently, there are significant obstacles to open education and collaborative course development in higher education. While open education offers free material and should be an easy sell to faculty members, in practice, many will want to safeguard personal intellectual property (IP) over the course they have created instead of considering course authorship as participation in a collectively shared good to be built upon, for which purpose Creative Commons was created. The hope for a more open future rests perhaps mainly on the younger generation of scholars who, unlike some of their more experienced peers who were socialized in a context of strict intellectual property, are more open to participating in a collective undertaking and sharing or even forgoing intellectual property altogether. As a compromise solution, one can imagine multiple authorship being tied to learning objects and a peer-review process approving changes and versioning.

Another potential obstacle is the cost of resources and money associated with increased institutional support. Investment is indeed required to put a team together. However, most team members are usually already employed, working, for example, at an institution's centre for teaching and learning or IT services department. It would be more a question of purposefully reallocating resources on project-based tasks than hiring new positions. As for faculty, an initial time commitment may be in order, but the group approach would certainly represent considerable time savings in the long run. And that is not counting the benefits—in terms of professional growth, stimulation, and inspiration—of being part of a community of practice and am engaged group of colleagues.

Not all courses would need to be created in collaboration. The best candidates, for reasons suggested in Keup (2018), would be the first- and second-year courses, especially the larger ones that form a discipline's basic knowledge. Once a course is created, every future iterative change would be incremental and would likely require little comparative effort. Courses would be built in a modular design, allowing instructors to adjust the course according to their academic vision.

6. Conclusion

What the future of technology-enhanced teaching and learning in higher education should look like becomes much clearer when guided by explicit pedagogical principles. We have adopted three guiding principles based on a conception of ideal learning passed down from classical tradition. Not all may agree that these should be the triumvirate governing our efforts in educational innovation, nor to what extent. However, it is safe to assume that there is some degree of consensus on their validity, allowing us to bypass debates between schools of thought. It is hard to imagine any teacher, even the most committed proponent of cognitive and behaviourist approaches, disagreeing that broader access to education, tutoring conditions, and more active and engaged participation in the learning process enhance pedagogical practice. Some may adhere to other principles, such as efficiency, but Skinner himself demonstrated improved efficiency by referring to gains in accessibility; personalized, self-paced, and immediate feedback; and active engagement in one's learning. It seems that some validity is generally associated with our principles. Some may wish to integrate other guiding principles in their reflection on pedagogical innovation, but the three principles we focused on should be sufficient in guiding concrete instructional decisions. Sometimes, less is more.

These principles also prove helpful in prioritizing the technologies worthy of being adopted. Technology can contribute on all three fronts, as the previous sections illustrate. In addition to the principles of pedagogical innovation, practical considerations for realizing the future state were also identified. Our ideal can come to fruition only when education becomes collaborative and course creation builds incrementally on previous educational iterations. Teaching should not be a solitary pursuit of professedly all-knowing teachers but a collective endeavour drawing knowledge and skills from multiple professional resources with the common goal of creating the best possible learning environment. This is made possible through institutional support and collaborative design. In the end, it is about giving ourselves the practical and technical means to realize our vision.

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Notes

Note 1. “Early in 1911, the Edison Company announced a series of historical films to cover important phases of the American Revolution. The first, released in July, was entitled ‘The Minute Man.’ Number Two, soon to follow, was ‘Ticonderoga.’ And there were more. The first of another series, on natural and physical science, ‘Crystals: Their Making, Habits and Beauty,’ produced under the personal supervision of Mr. Edison,’ was released early in December 1914. Other forthcoming were listed as ‘The Cabbage Butterfly,’ ‘Cecropia Moth,’ ‘Life History of the Silkworm,’ ‘Magnetism’ (in four parts), and ‘Microscopic Pond Life.’”

Note 2. See Greene, 1926.

Note 3. However, future studies seem to be moving from strictly possible and probable to preferable futures. According to Sohail Inayatullah, “[i]n the last fifty or so years, the study of the future has moved from predicting the future to mapping alternative futures to shaping desired futures” (2012). See also Leahy, 2019.

Note 4. As the Greek word for midwifery is *maieutikos*, maieutics or the maieutic method has come to define the Socratic method of eliciting knowledge from students.

Note 5. Although the historical continuity of the Socratic method from ancient Athens has rightfully been put into question (Schneider, 2013), it did have an enduring legacy, first through the Hellenistic philosophies of Late Antiquity, to the dialectic method in the scholastic Middle Ages (primarily through the method of disputations) and the “re-discovery” of Socrates during the Italian Renaissance, where Socrates was stylized as the educator of Athens’s youth. Ficino’s goal was to dislodge the ritualized scholastic disputation and rekindle the more authentic Socratic method. “Authenticity” has no other meaning here than the adherence to the original experience of learning as it is presented in the Socratic setting.

Note 6. Emmanuel Kant takes this idea one step further, famously stating that a human being “is the only creature that has to be educated” and becomes human only “through education” (1803).

Note 7. In this regard, Rousseau’s thought coincides with Socrates’. “You have not got to teach him truths so much as to show him how to set about discovering them for himself. To teach him better, you must not be in such a hurry to correct his mistakes.” “Put the problems before him and let him solve them himself. Let him know nothing because you have told him, but because he has learnt it for himself. Let him not be taught science, let him discover it. If ever you substitute authority for reason, he will cease to reason; he will be a mere plaything of other people’s thoughts” (Rousseau, 1911).

Note 8. “As for my pupil, […] he exercises discrimination and forethought, he reasons about everything that concerns himself. He does not chatter, he acts. […] As he is always stirring, he is compelled to notice many things, to recognise many effects; he soon acquires a good deal of experience. Nature, not man, is his schoolmaster, and he learns all the quicker because he is not aware that he has any lesson to learn. So mind and body work together. He is always carrying out his own ideas, not those of other people, and thus he unites thought and action” (Rousseau, 1911).

Note 9. See John Rawls’ “Aristotelian principle” (1971). “[T]he Aristotelian Principle runs as follows: other things equal, human beings enjoy the exercise of their realized capacities (their innate or trained abilities), and this enjoyment increases the more the capacity is realized, or the greater its complexity.”

Note 10. At the same time, leading a life of excellence and virtue is possible only given the right societal and political conditions. A well-constructed society will bring about excellence through education, norms and laws, promoting actions considered good while sanctioning those considered bad (Clayton, [2020]).

Note 11. « C’est la raison pour laquelle ce pari de l’éducabilité m’est apparu probablement scientifiquement faux, bien qu’on n’en sache rien, mais éthiquement juste et nécessaire, parce qu’il est le pari sur l’humain. De même que m’est apparue sa portée heuristique : c’est grâce à ce pari qu’on se met en route et qu’on invente des moyens pédagogiques pour aider les êtres à apprendre et à grandir.” (Meirieu, 2009)

Note 12. “For things that we have to learn to do [in contrast with things that we do by nature], we learn by doing them” (Aristotle, II, 1103a33).

Note 13. There are many variants of this quote, the closest original being attributed to Plutarch from the first century AD: “the mind does not require filling like a bottle, but rather, like wood, it only requires kindling” (Plutarch, 1927).

Note 14. See for instance Coker, Heiser, Taylor, & Book, 2016; Fredricks, Blumenfeld, & Paris, 2004 and Yoder & Hochevar, 2005.

Note 15. “It is a laborsaving device because it can bring one programmer into contact with an indefinite number of students. This may suggest mass production, but the effect upon each student is surprisingly like that of a private tutor. The comparison holds in several respects. (1) There is a constant interchange between program and student. Unlike lectures, textbooks, and the usual audiovisual aids, the machine induces sustained activity. The student is always alert and busy.” (Skinner, 2003).

Note 16. Skinner quipped that “there is no reason why the schoolroom should be any less mechanized than, for example, the kitchen” (Skinner, 2003).

Note 17. This view aligns with Howard & Mozejko (2015) and other commentators who argue that low teacher confidence and the lack of specialized training hamper technology adoption in the classroom. However, I argue that given the complexity of the instructional tasks, higher education instructors should be relieved of the burden of technological expertise, as their focus should be on learning content, while other professionals take on the responsibility of applying learning technologies.

Note 18. According to Green and Little (2017), educational development is a “fuzzy” concept, but it is generally understood as aiming to “lead and support the improvement of student learning” (Popovic & Baume, 2016).