TechTrends
https://doi.org/10.1007/s11528-023-00900-7

ORIGINAL PAPER

The Ethical Consequences, Contestations, and Possibilities of Designs in Educational Systems

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Accepted: 9 October 2023

Abstract
Emerging technologies present new possibilities for schools, but also present ethical issues for designers. Ethical issues arising from the design, accessibility, adoption, and implementation of emerging technologies in schools are intertwined with existing power dynamics, hierarchies, and decision-making norms that perpetuate entrenched systems. Using a framework called the fives spaces for design in education framework as an analytical lens, we explore the ethical implications of two emerging artificial intelligence technologies in education: remote proctoring software and large language models. We find that designers adopting and implementing these emerging technologies must attend to the consequences of past design decisions and recognize that emerging technologies also create places for resistance and contestations. Lastly, by recognizing the wide scope of what can be redesigned, designers can start to see possibilities for redesigning in ways that are inclusive, equitable, and ethically conscious. Ultimately, we hope to begin a critical conversation about the two technologies by thinking about the sites of consequence, contestation, and possibilities in the designed cultures, systems, experiences, processes, and artifacts of schooling.

Keywords Design · Technology · Education · Artificial Intelligence · Ethics

> The coming of an 'electronic age' brings the stringencies of the profit system into even greater conflict with the potentialities such an age has for richer sociobiological economy.... The need for this coordination makes more pertinent than ever the social obligations of the designer as a designer. (Moholy-Nagy, 1947, p. 55)

Design provides a way to consider possibilities–possible "courses of action" (Simon, 1969, p. 111). Designers look for variables they can change in a design space and create paths that move from what is to possible desirable futures; "design brings forth what would not come naturally" (Krippendorff, 2005, p. 25). This also implies that designers, as those who have the power to create towards a "desirable future" have an ethical responsibility to design for just futures (Ishimaru & Bang, 2022).

Emerging technologies present new possibilities for schools, but also present ethical issues for designers. Designers conceive of, access, adopt, and implement emerging technologies in schools. However, the way designers do that cannot be untangled from deep-rooted norms that perpetuate past systems. For example, many local education budgets are tied to property tax revenues that reflect historical choices by policymakers from decades ago (Baker, 2021). Additionally, teachers in underfunded schools tend to use drill-and-practice software more than teachers in well-funded schools (Hohlfeld et al., 2008). Lastly, school districts with more financial resources tend to get better deals for software from companies like Apple or Google (Butrymowicz & Mathewson, 2018). Recognizing that technologies emerge within and as part of complex systems that are brimming with histories is vital for thinking through issues of ethics, equity, and power.

In this paper we will address issues of ethics, equity, and power of emerging technology through the lens of

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Published online: 09 November 2023

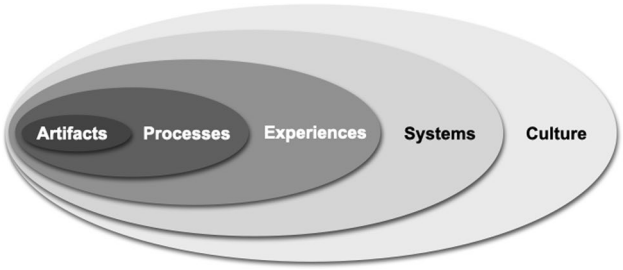

Fig. 1 The Five Spaces for Design in Education
Note. The five spaces for design in education shown as nested ovals with culture encircling systems encircling experiences and so forth. Although each space represents a scale of a design problem, they all intertwine

a design framework, the five spaces for design in education (See Fig. 1). Rooted in work positioning teachers and administrators as designers (Warr & Mishra, 2021; Weiner et al., 2020), the framework presents five spaces for design including:

1. Artifacts
2. Processes
3. Experiences
4. Systems
5. Culture

These five spaces can be thought of as sites bearing the **consequences** of previous design decisions (e.g., the decision to divide a school day into periods). They can also be thought of as sites for **contestation** where stakeholders working toward solutions using emerging technologies often experience unexpected resistance. More idealistically, they can be thought of as sites for reimagining **possibilities** (Beghetto, 2021). In other words, because almost everything is designed, from the shape and size of a desk to the culture of school-going, almost everything can be redesigned. Lastly, the spaces can be thought of as scales of a design problem, and the framework is a tool to think across these scales.

In this paper, we will use the five spaces for design in education framework to investigate the ethics of two emerging technologies in education: remote proctoring software (e.g., Proctorio, LockDown Browser) and large language model (LLM) chatBots such as ChatGPT. Pairing these two together as examples provides an illustrative juxtaposition of two pieces of technology that have or will carry **consequences,** invite **contestation**, and elicit opportunities for reimagining **possibilities** for the culture of educational institutions, our assessment systems, the way students experience school, our processes for testing, and the artifacts we will use to write and think.

Literature Review

What Are We Designing? The Five Spaces for Design in Education

Our use of the word design is based on the oft-cited definition by Herb Simon (1969): "Everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (p. 111). We emphasize two parts of this definition: first, what is considered a "course of action" and, second, what does it mean for a situation to be "preferred." We will begin with a focus on the first part: what are we designing?

We draw upon the work of several design scholars. First, perhaps the most well-known typology of *what* is designed comes from Richard Buchanan (1992, 1998). Buchanan used *areas* or *orders* of design to highlight the historical move from design as focused on visual or graphic communication to design of material objects, activities/services, and ultimately complex systems or environments. As design moves across these orders, required human abilities shift from inventing to judging, deciding, and evaluating. Buchanan described these orders as "places of invention... where one discovers the dimensions of design thinking by a reconsideration of problems and solution" (1992, p. 10).

Golsby-Smith (1996) similarly highlighted design as multi-faceted, describing design *domains* as a tool for broadening understandings of value in design. Instead of design domains being "places of invention and discovery" (as Buchanan described the orders of design), Golsby-Smith seeks to "explore these places with regard to a widening domain for design" (p. 5). The four domains begin with *word/image* and then extend to *object*, placing value in a designed artifact. The third domain, *strategic design planning* calls on designers to become facilitators and the value they bring to the situation is realized through their role as a facilitator. Finally, Golsby-Smith's fourth domain is *culture/system*. This domain moves design to a less tangible domain of values, beliefs, and a wide context. It addresses culture, integration, and systems. Culture, in this case, describes an activity; "the activity of ordering, disordering and reordering in the search for understanding and for values which guide action" (Golsby-Smith, 1996, p. 13).

A third scholarly approach to describing the broad nature of design comes from Krippendorff (2005). He described a *trajectory of artificiality*, where design has become more complex to address more complex problems. He highlighted five "phases of extending design considerations" (p. 6): products; goods, services, and identities; interfaces; multiuser systems and networks; projects; and discourses. This trajectory shifts design towards a more meaning-focused and human-centered emphasis.

Table 1 Definitions of each of the five spaces

Space	Definition
Artifact	(Relatively) Stable objects that can be perceived through the senses
Process	A procedure or directions that can be used outside of the context within which it was created to achieve a goal
Experience	A piece of time with associated sights, sounds, feelings, and thoughts
System	An organized and purposeful structure of interrelated and interdependent elements
Culture	A pattern of shared basic assumptions that allows groups to perceive and interpret the world in similar ways, develop and communicate meaning, and transmit values to new group members

Note. Definitions of the five spaces ranging from artifact to culture

The framework that we use in this article, the five spaces for design in education builds on the work of these scholars. We identify five spaces for design (artifact, process, experience, system, culture; see Table 1). Like Buchanan (1998), we see each space as a place of invention or reimagination of **possibilities**; a domain in which action can be taken to make a situation "more preferred." However, we extend the instrumental nature of the five spaces and propose they also provide spaces for considering **consequences** and **contestations**, allowing a deeper investigation into the intended and unintended effects of designs, and supporting a more ethical design practice.

Who is Designing? Power and Reproduction in Design

Using the lens of the five spaces to examine the ethical consequences, contestations, and possibilities of design in educational systems provides a tool for seeing spaces of design (e.g., for linking how newly designed technologies for remote proctoring reflect a culture around testing that has *not* been redesigned). This is a useful lens because it widens the view of what can be redesigned. However, redesigning something without simply reproducing the same problems (e.g., Benjamin, 2019, 2020), the same inequities, and the same entrenched power requires considering the role and the humanity of actual designers.

Scholars argue that creating new spaces, tools, and practices which defy reproductions of current entrenched power dynamics means thinking intentionally about how power, race, and culture play out in the way we practice design and conceptualize learning (Bang & Vossoughi, 2016). One way to do this is by considering three questions when designing: *for what*, *for whom*, and, importantly, *with whom* (Philip et al., 2018). Designers often cover the *for what* and *for whom* categories (e.g., designing remote proctoring software for university instructors), but may not include the *with whom* (e.g., with university instructors, with students).

Emerging technologies present exciting opportunities in education, but emerging technologies do not inherently reduce inequities or dislodge power dynamics. In 1980, philosopher Langdon Winner (1980) asserted that artifacts are often inherently political (p. 128), and their physical properties either require or are most compatible with certain social and economic patterns. "We find certain devices and systems almost invariably linked to specific ways of organizing power and authority" (p. 131). This means designers have the ability to impact social and economic structures, and with this power comes a responsibility for careful consideration of both intended and unintended consequences of a design. Sometimes the *with whom* question is considered, without attending to previously established power dynamics, dynamics that privilege one designer over another (e.g., the software designer may partner with a university professor giving input, but ultimately the software designer makes the design decisions).

Educational technologists need to consider the scope of who we consider a designer, incorporating intentional partnerships in educational designs. For example, Bang and Vossoughi (2016) intentionally treat "the domains of 'researcher,' 'theorist,' and 'designer' … as porous categories, open to the questions, concerns, ways of knowing, and designing that are both historically present within communities … and potentially asserted and developed in new ways" (p. 174). This also means attending to "(a) critical historicity, (b) power, and (c) relational dynamics shap[ing] processes of partnering" (Bang & Vossoughi, p. 174). Leaning on work by Gutiérrez and Jurow (2016), we are interested in how "new spaces, tools, and practices could be remediated and designed where youth could have dignity and take risks" (p. 20).

Investigating the Ethics of Two Emerging Artificial Intelligence Technologies in Education

Artificial Intelligence (AI) has received a great deal of media and popular attention lately, particularly with the release of chatbots based on LLMs such as ChatGPT, Bard and others. It is important to contextualize these new technologies

within the broader spectrum of AI. Broadly speaking, AI is the ability of a computer to perform tasks that normally require human intelligence, such as reasoning, learning, or understanding language. AI can be applied to various domains, including medicine, education, entertainment, and business. AI systems can range from simple programs that play chess or recognize faces, to complex ones that can potentially drive cars or write novels (e.g., LLMs).

Remote Proctoring Software

With the move from more in-person learning (e.g., classes at schools or training centers) to more at-home learning (e.g., online classes and asynchronous training) came the move from more in-person testing to more remote testing. Organizations that conduct tests, such as universities or companies that give out skills certifications, sought ways to ensure that test takers did not cheat when testing remotely. In this context, companies began to produce and sell AI-based remote proctoring software, such as LockDown Browser and Proctorio, to reproduce the task that in-person test proctors play.

What is Remote Proctoring Software?

These pieces of software reportedly confirm the identity of the test-taker and reduce cheating on online exams by ensuring that test takers avoid certain behavior predictive of cheating. These behaviors are flagged as potential instances of cheating, generally subject to further review. Sometimes remote proctoring software is used while a test proctor monitors behavior live online. Other times, remote proctoring software is used to monitor behavior for later review.

Driven by AI, remote proctoring software often confirms the identity of test-takers by accessing the cameras of test-takers and either confirming identifying documents (e.g., a driver's license or student ID) shown to the camera, using biometric face scans, or even analyzing keystrokes. Additionally, remote test proctoring software often monitors the test-takers' environment by asking test takers to rotate their camera 360 degrees or by flagging when other people enter the testing space and/or sounds in the environment. For example, to reduce the chance that someone is reading a note on their lap, remote proctoring software may automatically flag when a test-taker is looking down.

What is their Current use and Context?

In a 2016 report from *Educause,* the authors predicted, correctly, that "remote proctoring tools might become a staple of online courses" despite downsides such as "a wide range of ethical considerations accompany[ing] software that takes video of students" (Eckenrode et al., 2016, p. 2). In 2020, as the spread and uncertainty of COVID-19 impacted education systems, software which facilitated typical practices adapted for remote settings sold. The New York Times published an article titled "Keeping Online Testing Honest? Or An Orwellian Overreach?" (Hubler, 2020) in which Hubler estimated that the use of online proctoring software went up 900% in one year. However, questions remained concerning whether this software would "Stick around" (Young 2021). Young stated that, despite widespread opposition from student groups and some university leadership, 63% of colleges and universities in the U.S. and Canada indicate that they use remote proctoring software (2020). Remote proctoring software likely continues to be so popular because a) colleges and universities plan to continue to expand online learning options and b) more students are finding more ways to cheat, such as through paid services like Chegg which has a slick database of online quizzes and corresponding answers. Add into this mix the recent growth of LLM chatbots and you have a standoff with no clear resolution.

What are the Sites of Contestation/Reimagining Possibilities?

Unlike LLMs, remote proctoring software is not a disruptive technology. The adoption of remote proctoring software reflects a response to the move from more in-person learning to more distance learning. As schools moved to online courses, decision makers need tools for maintaining current (and even entrenched) assessment systems, and at-home test taking offered new types of cheating. Decision-makers attempted to solve this problem by investing in remote proctoring software.

Thinking about this development through the five spaces for design in education highlights just how little has changed in the design of schooling even as administrators adopted sophisticated and expensive emerging technology (e.g., remote proctoring software) for their schools. Here the artifact, remote proctoring software, is a **consequence** of previously designed and entrenched cultures, systems, experiences, and processes around testing. Though the artifact (e.g., the software) is novel, not much else has changed. Despite the momentous opportunity caused by the shift from in-person to online learning, administrators at schools which adopt remote proctoring software have not redesigned the culture and systems of testing in schools (See Fig. 2).

However, despite the design of remote proctoring software being a **consequence** of previous design decisions, it reflects stagnation in society's approach to assessment despite the historical shift from schooling in-person to schooling online. As a symbol it also became a potential site for **contestation** and, hopefully, a site of reimagining

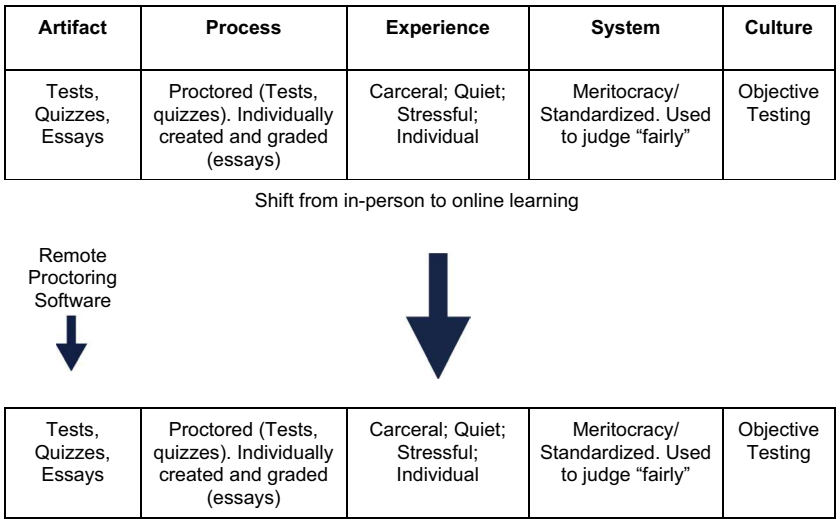

Fig. 2 The five spaces for design in education around testing and the shift from in-person to online learning
Note. The design of remote proctoring software is a consequence of entrenched designs around the culture, system, experience, and process of testing in schools

possibilities. As stated earlier, remote proctoring software spurred widespread opposition from student groups and some university leadership (Young 2021), an example of coordinated resistance to an emerging technology. In New York, for example, these protests led to legislation banning facial recognition technologies in schools (Wood, 2020). Legislators in New York are now considering further bans of facial recognition for businesses and landlords (Wood, 2020). Rather than reproducing inequitable systems, designers can work towards just futures by designing *with* students, families, and communities. This would offer new perspectives to reimagine the problem space. For example, they might reframe the problem. Instead of focusing on preventing perceived cheating, they might envision new processes, systems, and cultures for measuring learning, changes that may better align with measuring competencies needed to be successful in today's world.

Large Language Models and the Five Spaces for Design in Education

What are Large Language Models?

Another type of AI technology is LLMs. LLMs are deep neural networks that are trained on extremely large amounts of text data. Like all neural networks, the training uses complex machine learning strategies to identify and reproduce textual patterns, including those hidden to human perception. However, because of the broad extent of the training data, LLMs can generate natural language responses to prompts on a seemingly infinite range of topics, effortlessly answering questions, summarizing articles, composing emails, and even creating code or poetry. These texts are often (though not always) coherent, relevant, and sometimes even considered creative.

LLMs have been pejoratively described as "auto complete on steroids" or being equivalent to "stochastic parrots"—i.e. they are computer models that generate text by probabilistically combining linguistic forms from massive amounts of data, but without any reference to meaning or context (Bender et al., 2021; Peters et al., 2023). In other words, these systems are like parrots—they mimic words but do not understand what the words mean.As a result, LLMs can be wrong (often hilariously so), but they are often surprisingly good at what they *can* do. LLMs are particularly good when it comes to formulaic or genre writing and genre-mashing, such as writing a paper on astronomy in the voice of a 7th grader, or a sonnet on Franz Kafka's *Metamorphosis* in the style of Shakespeare. These models can also deal with counterfactuals and hypotheticals (what if Red Riding Hood never went to the forest, or what if the wolf were a cow). Clearly, there is some higher-level abstraction that enables this behavior (at least at the stylistic and genre convention level). It is often this slipperiness that makes it appear creative.

These characteristics make ChatGPT sound like a more-than-plausible interlocutor. This offers a challenge to educators: students can leverage the ability of LLM chatbots to write papers. These responses can reasonably and authentically reproduce prose about any topic without the student ever having to deal with the core ideas.

This clearly raises a serious question for educators and researchers such as how to prevent and detect plagiarism by students or authors who use LLMs to generate essays or papers. The fact that fine-tuned LLMs reduce verbatim plagiarism while at the same time increasing instances of paraphrase and idea plagiarism makes it difficult for human

evaluators and existing plagiarism detection software to identify machine-generated texts.

What is their Current use and Context?

Why are these tools receiving so much attention suddenly? It is not as if these AI systems had not been an integral part of our digital lives for over a decade. Neural networks and machine learning algorithms have been in use for a while, powering the autocorrect feature in our email clients, identifying people, locations and more in our photo albums among other things. We suggest that there are *four* key reasons that these LLM-based chatbots are fundamentally different from any previous technology.

First, LLMs have the ability to engage with humans through the medium of language, an ability that was until now restricted just to humans. Second, they can engage in extended conversations, with memory of past interactions, turn taking and more. Third, they can mimic genres of interaction, in ways that are both humorous and serious, demonstrating supposed expertise in various domains. Finally, LLMs have an almost inexhaustible knowledge of a massive number of domains (although it is prone to hallucination and confabulation).

The first three of these capabilities make these software-based interlocutors appear psychologically real to us; they present as having personality and agency. Thus, it becomes almost inevitable to ascribe psychological states (such as beliefs, desires, and intentionality) to them. In other words, these interactive, generative technologies are now psychologically real social agents in our world, engaging with us in ways that no other technology has ever been. This combined with the wide breadth and depth of its knowledge and its ability to make things up (hallucinate) lead it to being a potent disruptor of a variety of social systems, including education.

What are the sites of Consequences, Contestations, and Possibilities?

If we take the five spaces for design in education approach to thinking about educational design, these new AI-based technologies can cause change and disruption in all the five spaces. Thus far, many of the contestations of LLMs has been on how they disrupt standard assessment processes and systems (such as quizzes, tests, and essays), making it easy for students to cheat with little possibility of being caught. Thus, the entrance of this artifact into the world will inevitably lead to changes in evaluation and assessment processes.

Consequences of this focus on cheating could lead to several **possibilities**. If we remain entrenched in the current system of meritocracy and standardized testing, we could see a move back to classroom-based assessments without the use of technology or increased use of surveillance-based proctoring systems. Another **possibility** is perhaps more hopeful: if educators embrace these technologies in creative, productive ways, the processes and experiences of using LLMs in education could move educational systems from a focus on assessment of knowledge acquisition to evaluating so-called twenty-first century skills ("Partnership for twenty-first century skills", 2018) and the creative use of emerging technologies. Additionally, educators may find that having intelligent software agents can take some of the everyday drudgery out of the teaching process. Each of these decisions will have significant **consequences** on the nature of the student experience of learning, and educational systems will have to shift in response to the technology.

Another **possibility** of these agents could be the advent of software tutors that can monitor student learning and provide just-in-time support, fundamentally changing the nature of the teaching profession. **Consequences** could affect the process of becoming a teacher and teachers' daily experiences in the classroom. Broader systems (of textbook publishing, test preparation, and more) will have to adapt and change as well, and economically powerful entities will fight to maintain the status quo or at least to remain leaders within the education space.

Although the **possibility** of using LLMs to develop software tutors and ease some of the day-to-day challenges of teaching holds promise, taking a more critical perspective suggests potentially troubling consequences of this type of use, calling for **contesting** the vision of the role LLMs will play in teaching and learning. Recent research has illustrated the complexity of bias embedded into LLMs, including how it molds its responses based on student characteristics such as school-type, class, and race, magnifying the bias of its training data. If students interact extensively with an intelligent agent that is selecting tutoring strategies based on the biased traditions of current educational systems and culture (see Anyon, 1980), the use of these tools will increase inequity in education and widen the gap between affluent and under-served populations. Future LLMs could then be trained on this more-biased discourse, resulting in a vicious cycle of inequity. Thus, it is critical to consider a wide arrange of **consequences** of technologies, including their long-term impact on human experiences, systems, and culture that extend beyond the educational context.

Discussion

The five spaces framework offers a lens for investigating the consequences, contestations, and possibilities of emerging technologies. We have used the framework to explore two emerging technologies: remote proctoring software

and LLMs. In this section, we complicate the ideas we have presented by considering the consequences, contestations, and possibilities of social media as it has played out over time. This example illustrates the importance of considering consequences and possibilities of not only education-specific designs across the five spaces but also how emerging technologies can have a long-term effect on broader experiences, systems, and culture. Note, we are not arguing that social media should not be used or studied for educational purposes. Instead, we are highlighting potential impacts of limiting attention to education-related processes and experiences without regards for larger cultural impacts.

When social media—an artifact that has become part of human culture in many countries—first became pervasive, many scholars and educators focused on its **possibilities** for teaching and learning, and social media tools were widely used by schools and universities (Carpenter & Krutka, 2014; Schroeder et al., 2019). For example, in a study of 51,496 school websites, Kimmons (2020) found that in 2019, the most common technology tools K-12 school websites linked to included social media websites. When analyzing the top educational technology journals, Kimmons found social media to be in the top 10 educational technology topics discussed in academic articles in 2019. At the same time, very few article abstracts used terms connected to broader social issues such as the digital divide, equity, racism, or accessibility.

As educators and scholars focused on the possibilities for the use of social media in teaching and learning, social media technologies such as Instagram and YouTube were having a significant impact on young people's mental health. The **consequences** have been extreme. Social media increased young people's tendencies to constantly compare their own lives to the lives of others, reduced in-person social interactions, increased body dysmorphia, and engendered cyberbullying (The U.S. Surgeon General's Advisory, 2023). It changed human experience and culture, having catastrophic effects on young people. For example, alarming statistics reveal a tripling of the suicide rate among children aged ten and above over the course of a decade (Curtin & Heron, 2019). Moreover, the situation appears to be more severe for girls, who spend more time on social media compared to boys. Such concerns are of such magnitude that the U.S. Surgeon General recently issued an advisory specifically addressing the impact of social media on the mental health of teenagers (Cohen et al., 2022). Thus, while we were discussing **possibilities** for using social media in schools and classrooms, human culture and experience shifted, changing the kinds of challenges schools are expected to deal with.

Another impact of social media that is indirectly affecting schools is the polarization it has caused in society. Social media is built to deliver content that reaffirms users' opinions, creating information bubbles that were further exacerbated existing rifts and schisms in society. Vested interests, motivated either by seeking greater advertising revenue or in spreading their radical views stepped into these spaces resulting in the rampant spread of misinformation and/ or increased tribalism (Stubenvoll et al., 2021; Turcotte et al., 2015). As an indirect consequence of this, we are seeing fringe perspectives becoming politicized and radicalized. There are of course many consequences of this including a backlash against public education and its role in a democratic society. Whether it be book bans or laws against teaching specific content (even content that is not taught in schools such as critical race theory, see Cobb, 2021; Teitelbaum, 2022), social media has had a deleterious influence on broader social and educational discourse. This is not to say that school curriculum should not be questioned or even **contested, or that social media is all bad,** but rather we seek to highlight the unanticipated consequences of the spread of a technology that can lead to large-scale cultural shifts, which in turn can change the broader social context within which education functions.

Our discussion about the possibilities and consequences of social media illustrate a principle referred to as Amara's Law, named after Roy Amara, an esteemed American scientist, futurist, and President of the Institute of the Future. Amara's Law is encapsulated in his renowned adage that states, "We have a tendency to overestimate the impact of a technology in the short term and underestimate its impact in the long term" (What is Amara's law, 2022). This insightful observation pertains to the common phenomenon where individuals swiftly become enthralled by the potential and transformative nature of new technologies, often leading to a narrow focus solely on the capabilities of the technology (the artifact and perhaps processes or experiences it enables) in question. Consequently, people may either become overly enthusiastic, perceiving only the positive benefits, innovation, and efficiency it can bring to their lives and businesses, or they may envision it as a destructive force threatening the status quo. However, as time progresses, the initial excitement surrounding the technology diminishes, and a reflection on past visions—both utopian and dystopian—appear exaggerated. Nevertheless, we often fail to recognize the longer-term and unanticipated changes or consequences that new artifacts can have on human existence and society through shifting systems and cultures, both for the better and worse. Neil Postman (1998) contends that technological change is not merely an additive process; rather, it is an ecological one, where the introduction of a new technology profoundly alters the entire system, making it challenging to foresee all its consequences. However, imagining the **possibilities** and **consequences** of technologies across *all* five spaces for design can engender broader perspectives and even lead to **contestation** of applications that could have negative long-term consequences.

Emerging AI technologies will transform our social, political, entertainment, and economic structures in ways that we cannot predict. The rise of misinformation will only grow with the ease with which tools can generate precisely targeting messaging which will have significant consequences in the space of politics and the radicalization that we are already seeing in the political space will only increase. These impacts, combined with changes in jobs that are inevitable and other social upheavals (e.g., climate change, see Kumar & Davenport, 2023), mean that the role of educators will also have to change to focus on how we develop the next generation of citizens.

In this context, designers have an important role to play:

> While a traditional tool waits for someone to use it, AI programs can … somewhat autonomously react to, and affect their environment. Due to this, the ethical considerations traditionally applied to the design and use of technology (safety mechanisms, emergency buttons, etc.) no longer fill the needs behind AI systems. As a tool gets more autonomous, the responsibility for its ethical use gets farther away from its intended user and needs to consider a broader set of scenarios (Casas-Roma et al., 2021).

In other words, designers may have a bigger role in ethical decision-making than ever before.

The five spaces framework offers an analytical tool for reflecting on ethical consequences–both positive and negative–of designs in education. The five spaces also suggest areas for transforming education from what it is to what it could be. Ultimately, we hope to begin a critical conversation about emerging technologies by thinking about the sites of consequence, contestation, and reimagining in the designed cultures, systems, experiences, processes, and artifacts not only in direct relationship to teaching and learning, but also in broader changes that impact education.

Declarations

All authors have no known affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. We conducted no research involving human participants and/or animals, hence no informed consent processes were necessary for this paper. The authors did not receive support from any organization for the submitted work.

Conflict of Interest We have no known conflicts of interest.

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