Spring 2024

How is Technology Shaping the Future of Study?

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EDITED BY
Steven M. Baule
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A student project from the 2023 Winona State University's Doctoral Residency Program

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2024

WINONA
STATE UNIVERSITY
COLLEGE OF EDUCATION

The essays in this book are selected from doctoral students as part of the 2023 Doctoral Residency course. The residency course is a core portion of the WSU education doctorate program.

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Book printing coordinated by the Winona State University Darrell W. Krueger Library. Special thanks to Kendall Larson for her assistance.

ISBN 9781948397100

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Introduction: Navigating the Nexus of Technology and Education

Steven M. Baule

In the dynamic landscape of the 21st century, technology and education have become inextricably linked, shaping the contours of learning and teaching in profound ways. The integration of technological advancements into the educational sector has sparked a revolution, transforming traditional classrooms into vibrant ecosystems of digital learning and innovation. This book, a compilation of insights from the 2023 Winona State University's Doctoral Residency Program, delves into the complexities and nuances of this transformation, offering a comprehensive exploration of how technology is reshaping the educational experience through the eyes of the residency students and the disciplines in which they work.

At the heart of this exploration is a fundamental question: How is technology shaping the future of study, and what are the potential benefits and drawbacks of these technological advancements? The essays within this volume, contributed by emerging scholars and practitioners, seek to address this question through a multifaceted lens, examining the impact of technology on various aspects of education—from pedagogy and curriculum design to accessibility and equity.

The journey into the digital educational landscape begins with a historical perspective, tracing the evolution of technology in education from the early adoption of print media to the current proliferation of digital tools and platforms. This historical context sets the stage for a deeper investigation into the current state of educational technology, highlighting the transformative potential of artificial intelligence, machine learning, and other digital innovations.

As the digital age accelerates, educators and students alike are navigating a new realm of possibilities and challenges. The book critically examines the role of technology in enhancing learning outcomes, democratizing access to knowledge, and

fostering inclusive educational environments. It confronts the potential pitfalls of technological integration, including issues of the digital divide, privacy concerns, and the impact of screen time on cognitive development.

The pandemic era, marked by a sudden shift to online learning, has further underscored the critical role of technology in education. This volume reflects on the lessons learned during this unprecedented period, analyzing how emergency remote teaching has influenced pedagogical practices and educational policy. It offers a vision for a post-pandemic educational landscape, where technology continues to play a pivotal role in shaping learning experiences but is balanced with a renewed emphasis on human connection and holistic development.

Moreover, these essays venture into the future, speculating on the next frontiers of educational technology. They explore emerging trends such as virtual and augmented reality, blockchain in education, and the gamification of learning, contemplating their potential to revolutionize educational paradigms. The contributors offer critical perspectives on how these technologies might shape the future of education, emphasizing the importance of ethical considerations and the need for educators to adapt to a rapidly changing technological landscape.

In addressing the multifaceted relationship between technology and education, this volume does not shy away from the contentious debates and ethical dilemmas that accompany technological advancement. It engages with critical questions about equity, accessibility, and the human dimensions of learning in a digital age. Through a collection of essays, the book captures a diverse range of voices and perspectives, highlighting the richness and complexity of the dialogue surrounding educational technology.

As the chapters unfold, a recurring theme emerges: the necessity of a balanced approach to technology integration in education. The contributors advocate for a model of educational technology that enhances, rather than replaces, traditional pedagogical methods. They call for a critical examination of how technology is implemented in educational settings, urging educators, policymakers, and stakeholders to prioritize

pedagogical goals and the well-being of students above technological imperatives.

This book is a testament to the power of technology to transform education, offering both a cautionary tale and a roadmap for harnessing digital tools to enrich learning experiences. It serves as a valuable resource for educators, students, policymakers, and anyone interested in the intersection of technology and education. As we stand at the crossroads of a new era in education, this volume invites readers to reflect on the role of technology in shaping the future of learning, challenging us to envision an educational landscape that leverages technological innovation to create more equitable, engaging, and effective learning environments for all.

Acknowledgements

Thanks to a member of the Elementary and Early Childhood faculty, Liberty Kohn of the English faculty, and Dr. Kohn's ENG 440 / 540 Professional Editing student for their assistance in editing this text.

Fighting the Last War: Artificial Intelligence in Education

Jordan O'Connell

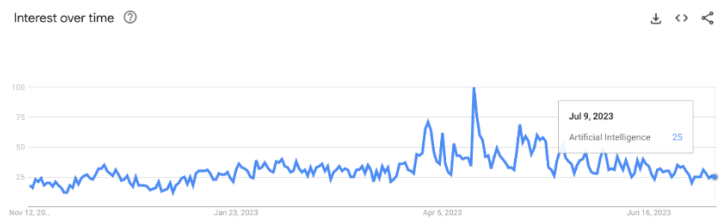
Education, once again, is being upended by a new technological epoch. Where earlier revolutions in the field were symbolized by newfound speed (the printing press) and connectivity (the computer modem), the revolution today is driven by artificial intelligence (Rousseau, 2023). Powered by new large language models and carried into our lives through a tightly knit Internet of Things, artificial intelligence (AI) will inevitably transform both how instructors teach and how students learn. As academia faces a perplexingly inhuman reshaping of its institutions, systems, and networks, educators will be called upon to integrate AI technology into their teaching practices to prepare students for the cognitive revolution to come.

A Tool, a Pet, a Mind

Debates about artificial intelligence playing out across academia show few signs of abating. Figure 1 shows surging Google search trend data for the term "ChatGPT" beginning in the fall of 2022, supporting concerns about a potential "homework apocalypse" looming this academic year (Mollick, 2023). Despite the foreboding tone of much of the discourse, artificial intelligence and machine learning are finding a

Figure 1

Google Search Trend Data for "ChatGPT" (November 12, 2023, through July 12, 2023)



comfortable home in many of our academic research and classroom spaces. Popular AI-powered "intelligent tutoring systems" like Grammarly already offer personalized learning assistance that adapts to individual students' needs (Crompton & Burke, 2023, p. 16). Researchers across academic disciplines are using machine learning algorithms to analyze prohibitively large data sets to uncover otherwise hidden knowledge and insights, including the recent discovery of the antibiotic compound abaucin (Liu et al., 2023). Additionally, cloud-based data storage, processing, and analysis tools are now available to educational institutions at a mere fraction of their previous costs. Marber (2023) credits the technology boom of the past two decades, noting that "Machine learning, and cloud computing are now abundantly accessible through services offered by companies like Amazon, Google, and Microsoft… [making possible] complex individualized instruction tailored to specific needs" (p. 261).

These technological advancements show significant promise in both improving the quality of instruction and further democratizing access to knowledge. Artificial intelligence and machine learning can enhance education efficiency through personalized learning, predictive analytics, and automated assessment and feedback. These tools can help instructors strengthen academic outcomes and better align program curricula. The Internet of Things, bolstered by tens of billions of dollars in new federal investments in 5G and high-speed internet connectivity (Public Law 58, 2021), will help make the educational experience of tomorrow interactive and engaging in ways that may be unfathomable today. For instance, in the recently published book *The Age of AI*, former Google CEO Eric Schmidt and former Secretary of State Henry Kissinger (2023) envision a future in which parents enlist in-home AI assistants to help tutor and raise their children, explaining, "AI will increasingly appear to humans as a fellow being experiencing the world; a tool, a pet, a mind" (p. 212).

Confine it, Partner with it, or Defer to it

These technological advancements amplify potential drawbacks and ethical concerns that have been present since the advent of Google's internet search engine at the beginning of the

21st century. Old questions about data privacy and security, algorithmic bias, and potential misuse of information technologies reveal the ways in which educators continue to fight the last war. Like with Google search, over-reliance on AI will weaken our uniquely human capacity to learn and undermine the vital role of instructors, "diminishing human thinking and judgement abilities" (Hao Yu, 2023, p. 2). Like search engine optimization, AI systems trained on biased data or data attenuated by developers to achieve mutable objectives will perpetuate and amplify those qualities in their outputs. No matter whether one considers the scientific calculator, the internet search engine, or an AI chatbot, Schmidt and Kissinger (2023) offer a familiar caution, "The greater a society's digital capacity, the more brittle it becomes" (p. 189).

It is almost inconceivable that recent technological advancements in artificial intelligence and machine learning will not continue to shape education in ways practitioners cannot fully account for or predict. Academic professionals in both teaching and administrative roles will need to acquire new skills and knowledge to adapt. They will need to understand how to effectively integrate AI technologies into their own educational practices, how to interpret and apply new data insights, and how to navigate the ethical and legal implications inherent to technologies that will inevitably "democratize cheating" if left unchecked (Oluwaseun Kolade et al., 2023, p. 2).

Educational institutions will play a crucial role in preparing students for the cognitive revolution Paul Scharre describes in *Four Battlegrounds: Power in the Age of Artificial Intelligence* (2023). Schools and universities will need to incorporate relevant technology-focused courses into their curricula, provide hands-on opportunities for students to engage with these technologies, and foster a culture of lifelong learning and adaptability. Institutions should also consider the moral implications of these technologies and incorporate new ethics training into high school and college curricula, much like they did with internet search engines at the turn of the millennium. As Schmidt and Kissinger (2023) conclude, "We can do one of three things with AI; confine it, partner with it, or defer to it (p. 213).

Educators should heed this realpolitik and realize that fighting the AI is simply not an option.

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Less vs. Excess: How Technology Affects Minimalism in Education

Rebecca Simataa

One of the changes that veteran teachers explain as a difference between when they started their teaching career and their current experience with teaching is the increased amount of everything they have to do: more meetings, more paperwork, more emails to check, more standards to meet, more students with needs, more behavioral problems, more testing, more students with more papers to grade, and fewer resources and less time to do it all. An article by Robbins (2023) from *Education Week* argues that–while some explain these stressors as teacher burnout–the reality is that educators are set up to fail. A *New York Times* article asserts that over half of current educators are trying to get out of the profession by quitting and considering other options (Rizvic, 2023). Clearly, there is a problem. Teachers have too much to do, and students feel the effects of teachers' stress (Bouchrika, 2022).

While it is not an antidote per se, there is a concept that helps teachers prioritize, simplify, and work efficiently: minimalism. Minimalism is the idea of choosing the simplest form that still contains meaning. The opposite of minimalism is maximalism, clutter, excess, and busyness. In education, minimalism is about simplifying practices and routines throughout teachers' curriculum, instruction, classroom space, and habits; for example, a minimalist teacher may choose to only grade one skill at a time or use cluster seating to save floor space. It is about taking the less-is-more approach, as long as "less" is purpose driven.

As teachers' work has become busier and more maximalist, educators have had to change with the times by adding technology into their day-to-day lives. New waves of technology keep appearing. With almost seven billion smartphone users across the world (Center for Humane

Technology, 2023) and ChatGPT on the rise (McKinsey & Company, 2023), technology is here to stay. Educators have embraced ways technology can support a more streamlined way of learning and teaching through timesaving, organizational, and student-centered technologies. However, the world of technology is not all positive, especially not when it comes to striving for a life of less excess. Technology can be overwhelming through adding clutter, and it can cause a range of mental health issues and ethical concerns because of its pervasive nature. Put simply, technology can either support or hinder minimalism in education. In order to empower teachers' request for minimalism, educational institutions should prioritize two action steps around technology: educate teachers to thoughtfully use technology as a tool and mold future technology to support equitable, essential, and ethical education.

Technology's Positive Effects on Minimalism

Before teachers choose how they use technology in their professional spaces, they need to be aware of how technology can help them to improve efficiency, organization, and students' autonomy.

Time

One significant benefit of technology in education is its ability to minimize time spent on routine tasks. Technology can simplify day-to-day routines through something as simple as automating one's laptop to pull up the needed tabs and windows for the day. Technology can save time through knowing and using keyboard shortcuts. In addition, educators benefit from time-saving technology grading tools. Some of these tools offer faster ways to annotate students' papers to provide feedback, like Floop (WeAreTeachers, 2023), while others innovate the nature of old-school grading by leaving voice notes for students through tools like the Google extension Mote or voice system Vocaroo. These feedback features are meant to be personal, student-specific, and–if used thoughtfully–efficient, saving teachers hours upon hours of time spent grading.

Generative artificial intelligence (AI) technology, such as ChatGPT, is on the rise and has the capacity to support teacher-created content and even replace some of a teacher's tasks. Generative AI can help teachers create curriculum and instruction: unit outlines, lessons, assignment prompts, discussion questions, slideshows, posters, rubrics–and that is just the tip of the iceberg (Finley, 2023). With ChatGPT, teachers can easily modify assignments and texts, leading to a more differentiated classroom that more equitably serves all students (Finley, 2023). McKinsey & Company (2023) states that anyone will benefit from using ChatGPT if they have a goal of writing clearly. If teachers choose, they have an infinite number of time-saving resources at their fingertips with ChatGPT.

Furthermore, even if teachers choose not to engage in the whole wide world of generative AI, teachers can–with minimal time and effort–find professional development and resources online through blogs, forums, podcasts, and other sites. There, teachers can research ways to simplify their practices or share their successes and questions. Additionally, educators can find some ready-to-use resources themselves through a quick search on databases, such as *Teachers Pay Teachers* where teachers can purchase lesson plans, posters, and other classroom materials created by other teachers at a minimal cost. With time being one of teachers' most precious resources, minimizing time spent on mundane, everyday tasks allows teachers to focus their energy on students and their needs.

Organization

While technology can help educators save time and work more efficiently, technological tools can also help teachers and students organize themselves to lessen the chaos and be more productive. Numerous technology applications exist for this exact purpose: to help individuals in their productivity. One example of many possibilities is the Pomodoro clock app (Pomofocus, 2023). With the Pomodoro app, teachers can prioritize a checklist of to-dos and stay more focused by having designated work time and break time.

Another technology tool that helps with organization is the concept of Learning Management Systems (LMS), which are spaces where teachers store course material for students to access and complete work. Some common LMSs include Canvas, Google Classroom, and Schoology though some experts argue Google Classroom does not count as an official LMS (Langreo, 2022). Although the learning curve may be overwhelming for educators at first, the LMS should ultimately end up simplifying courses because they provide an organized platform for all of the course materials to exist in one location, and teachers can duplicate an entire course's materials for other classes; that way, teachers do not need to go through the busy work of doing the same task over and over for five different courses. Furthermore, if a school only uses one type of LMS, students' experience with learning is simplified even more by having to learn only one system to be able to access all their resources (Langreo, 2022). Using an LMS should simplify teachers' and students' lives as well as support equity and access because all students have an organizational system set up for them through this platform. LMSs can support students with disabilities by offering consistency, accessibility features, and other organizational features, such as to-do checklists, due date notifications, and late work reminders (AccessComputing, 2023). When used purposefully, technology tools support teachers and students in their pursuit of management and organization.

Student Independence

Technology tools, like LMS, can benefit educational systems by minimizing student dependence on teachers and increasing students' agency and autonomy. In an article by the National Institutes of Health, Saiz-Manzanares et al. (2019) argue that, if created and scaffolded purposefully, LMS help students self-regulate their learning and allow students the opportunity for personalize learning, often able to work at their own pace. Tools like Google Forms can offer students immediate, automated individual feedback. Setting up a proper LMS takes time for teachers on the front end, but frontloading

pays off. Students become more independent, freeing up teachers to work on other tasks and support students in other ways.

Some educational technology is even set up for students to work independently. There is a plethora of educational websites students can visit to learn new skills and concepts. In-class teachers are not the only "teachers" students can learn from, as the Internet is rife with learning opportunities. One website that supports teachers in setting up student-paced work is the Modern Classrooms Project (2022). In response to using the Modern Classrooms Project approach, teacher Beth Mercer writes, "Students have taken responsibility for their own learning. I know exactly where my students stand in the learning process. I am better able to differentiate and provide supports and challenges as needed for my students" (Modern Classrooms Project, 2022, n.p.). When students take ownership of their learning through accessible systems, teachers have less handholding to do, freeing up their hands and minds to provide more individualized support than what would have been possible without technology.

Technology can clearly benefit education through minimization by maximizing time, organization, and student independence. However, these technological tools and advancements are not without their faults, as technology has the potential to do more harm than good when it comes to adding busyness, clutter, mental health issues, and ethical issues.

Technology's Negative Effects on Minimalism

Teachers may not be aware of all the detrimental ways technology clutters their lives, but according to a 2021 meta-analysis published by the National Library of Medicine, teachers have increasing levels of stress and anxiety over using technology in their classrooms (Fernandez-Batanero et al., 2021). Knowing these technology-based stressors can help teachers choose a more minimalistic path forward.

Busyness and Clutter

Although various technological tools support minimalism, technology is still rapidly advancing, and the

overall amount of requirements can easily add to teachers' level of busyness and clutter. One example of the overwhelming nature of our technological society is email. Edutopia writer Terada (2021) claims teachers receive up to 100 emails per day. Forbes' Senior Contributor Segal (2021) shows related results but not just for teachers: workers, on average, are loaded down with over 120 emails every day. Even if teachers receive half of that amount, they still may feel inundated with email fatigue–the feeling that a full inbox can lead to a heavy mental load (Segal, 2021). Sadly, emailing is only a miniscule component of a teacher's to-do list (rather than, say, an office worker who sits at their desk all day). To add to that, the increased use of technology during the last couple decades allows for 24/7 communication; parents and students email at all times of the day, night, weekend, and even holidays. While it is hard to ignore the constant notifications, teachers are subtly–sometimes not so subtly–expected to respond quickly, especially to student and parent responses. Terada (2021) argues, "The mere expectation that an email or text may arrive from a principal or student, and demand a response, is an intrusion into a teacher's personal space" (n.p.). The number of emails and the mental pressure that comes with it all is overwhelming. Simply put, teachers end up having to work overtime to do everything in their job descriptions. In fact, even though most teachers' contracts are for 180 school days, a We Are Teachers article calculated that teachers work 2,200 hours per year, which equals 42 hours per week, working year-round (McLoud, 2019). Therefore, communication technology and other excess technologies become an overall burden rather than a benefit.

Emails are just one example of how technology can add more to an educator's already-full plate; in reality, all the aforementioned technology tools that can help save teachers' time, help with organization, and increase student autonomy can–all together–be too much and feel like clutter. All these tools can take away from the fundamental skills students need to learn, and teachers may feel like they are playing a game of whack-a-mole every time new technologies pop up. With teachers already making around 1,500 decisions per day (Klein, 2021), having to sort through new technological tools (or sometimes having

technology forced into a classroom) creates further decision fatigue, which the American Medical Association says is the cumulative wearing-down of decision-making (Berg, 2021). Some technological tools that gamify education especially lead teachers down a path of excess, where tools start to become the focus of an activity (rather than being a supplemental aid in learning). While technology has its place as an engagement or motivational gimmick, these types of technology should not be the objective of a lesson. Educational institutions need to be wary of the purpose and amount of technology coming through their doors.

Student Mental Health

In addition to technology adding excess and busyness into education, technology can also be a source of stress and anxiety for students. Even though LMSs are set up to help students with organization and independence, many students struggle to navigate these new online spaces and do not have the capacity to take in so much information at once, especially if teachers are not consistent (Murphy & Cunningham, 2022). This platform meant to help students may end up overwhelming them.

On top of the excess of educational technology, students deal with mental health issues born from an excess of social media usage. Even if students do not use social media at school (which they likely do), the effects from social media absolutely permeate the classroom walls. The Center for Humane Technology (2022), a nonprofit organization set up as a watchdog for technology usage, lists a few of the many ways technology (especially social media) negatively impacts youth: limited attention spans, cyberbullying, depression, behavioral issues, decreased self-image and social skills, worse learning and grades, poor sleep, delays in language-learning and problem-solving, and addictions. These issues inevitably influence how students act, behave, and think within classrooms–and not in positive ways.

Ethical Concerns

In addition to adding to busyness and mental health issues for teachers and students, technology can be harmful by adding in ethical concerns through its potential minimalism. Technology raises ethical questions that are not easily answered.

Who is behind the technology?

Yes, technology tools can help with minimalism but are not necessarily focused on learning and best practices. For instance, many "tech platforms are still incentivized to maximize attention [using] addictive design, targeted content, and AI-powered feeds to hijack attention and increase time on platforms" (Center for Humane Technology, 2022, n.p.). Put simply, most of the technology used in classrooms is not created by educators but instead by corporations whose end goal is to make money, not to enhance the values and minds of young people. Students often are the victims of technology corporations trying to make an extra buck, and their mental health and well-being suffers from the excess inherent in the making of the product. Because corporations create these technology tools teachers use in their classrooms, these businesses are the puppeteers behind what educators understand to be current practice. They have influence not because they are in tune with best educational practices but because they have the loudest voice in the room, which raises the ethical dilemma that corporations, rather than educators, are molding the future of education.

Whose intellectual property is generative AI?

While students or teachers may think they are minimizing their workload by using AI-generated tools such as ChatGPT, they are really adding on a heap of ethical concerns. The nature of AI has questionable beginnings, as many recent legal cases claim AI was training using unlicensed sources (Appel et al., 2023). Furthermore, AI may make students' lives simpler now, but it could bring about legal troubles for them in the future if they claim intellectual property from generative AI in their future workplaces (Appel et al., 2023). Because AI is legally and ethically murky, if students get in a habit of claiming

generative AI as their own now, they may be setting themselves up for potential failure.

Does ChatGPT help students think and learn?

Current generative AI technology allows students to bypass tasks through having tools like ChatGPT help with assignments and other learning. However, these resources allow students the ability to think less–or not think at all–when engaging in the learning process. Instead of spending hours struggling and working through intensive thinking using the writing process, students can simply input a prompt and a few qualifiers for a "solid A- essay [...] in ten seconds" (McKinsey & Company, 2023). It is, at best, morally questionable for students to "earn" top grades with no effort or learning to show for it. ChatGPT becomes ethically complicated even further by generating unethical content; McKinsey & Company (2023) writes that ChatGPT almost always creates citations that are inaccurate, flat-out wrong, or even biased. As teachers work to inform students on accurate, reliable, unbiased sources, ChatGPT works against these principles. Minimal effort in some cases helps students and teachers to breathe, focus, and prioritize what is most important, but the ethical expense of generative AI is costly and often anti-educational.

Future of technology and minimalism

With both advantages and disadvantages to using technology to improve minimalism in education, a challenge moving forward is keeping quality education the focus. To prioritize what is best for students, educational institutions need to take action steps for a positive future of technology and humanity's relationship with it.

Empower Teachers through Education

The first priority educational institutions need to act on is preparing all teachers to interact with technology healthfully. A case study conducted in 2016 analyzed how 9th-12th grade teachers were trained in technology. Sharick (2016) found there was not effective professional development around technology uses and implementation, which meant that teachers' own

technology self-efficacy was what determined the kind and extent of technology use in their classrooms. Following the case study, Sharick (2016) argues that schools need to teach educators available technologies and how to use those technologies effectively in learning. A 2020 article by McKinsey & Company agrees: "Technology must be used correctly to be effective. Our experience in the field has taught us that it is not enough to 'add technology' as if it were the missing, magic ingredient. The use of tech must start with learning goals, and software selection must be based on and integrated with the curriculum. Teachers need support to adapt lesson plans to optimize the use of technology" (Bryant et al., 2020, n.p.). This training in technology is essential for pre-service teachers as well as all teachers currently in the field. While professional development around technology might feel like yet another stressor for teachers, the goal needs to be on effectiveness—on quality over quantity. Training needs to be continual and up to date as new technologies arise (Williams, n.d.), and leaders in charge of training should be selective about what technology fits best with the latest research–and what technology is *educationally* worth investing in and helps minimize rather than maximize the lives of teachers and students. Finally, training is not enough. Teachers need time to adapt curriculum as new technology offers improvements to education as we know it (Bryant et al., 2020). Technology is a step toward more powerful education, and education is the first step toward empowering technology.

Mold Future Technology to be Centered on Equitable, Essential, and Ethical Education

The second priority around technology and minimalism for educational institutions is to make sure there is a voice at the decision-making table. Educators should be the ones molding future technology and molding *the future* of technology through making sure technology in schools is values-based. As the Center for Humane Technology (2023) aptly states, "When we invent a new technology, we uncover a new class of responsibility. It's no longer okay to say it's someone else's job to define what responsibility means" (n.p.). As a part of defining what responsibility means, educational leaders should evaluate

technology based on ethics, equity, and what is essential. As mentioned earlier, ethical dilemmas will arise with new technology, so educators' first task is to define values around what are ethical and unethical uses and aspects of technology. McKinsey & Company (2023) underlines this idea by noting that leaders will need to stay in touch with the latest information to do a current, accurate cost-benefit analysis based on pre-set ethical values. The second determiner in molding future technology is looking at equity and accessibility, especially considering how marginalized individuals will experience technology differently. Corporations creating technology have varied values behind their creations, and some technology does more damage than good (NCES, n.d.). The third consideration for educators should be a no-brainer; technology absolutely must fit in with essential tenets, with foundational skills. Technology can be distracting in certain spaces, but educational institutions should uphold a level of integrity by keeping education about learning key content and skills–not about playing Candy Crush or hacking systems. By maintaining ethics, equity, and essentiality, educators will maintain a voice in the ever-important conversation around technological use and values.

Conclusion

Technology can have positive or negative effects on minimalism in schools. Current technology allows teachers to save time, stay organized, increase productivity, and teach students autonomy. However, many of those same technologies can add more rather than less: more stress, more mental health problems, and more ethical issues. To benefit from technology and give power to the user, educational institutions must support sustained teacher training and value-based efforts in shaping future technology. Only after prioritizing what is best for teachers and students will educational spaces be able enjoy the life-giving freedom of minimalism.

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Unlocking Potential: The Role of Technology in Elementary Education

Jennie Danneman, Lindsey Reishus, & Hanh Bergerson

Technology has played a significant role in shaping K-12 education and will continue to disrupt the future of education. It may appear that advanced technology is constantly transforming K-12 classrooms in ways never seen before in the twenty-first century. However, technology and education have a long history of co-evolving and dramatically shaping educators' pedagogies and students' learning (Huls, 2022). Genjendharian et al. (2020) state that the traditional curriculum in the USA shapes students to be productive and knowledgeable researchers who are not particularly innovative or creative. Technology disrupts the typical patterns and curriculum. This can help develop a new understanding of education and increase the creativity and innovation of students. The current state of technology in education is in part a product of the history of pedagogical methods, the coronavirus pandemic, and the way teaching transitioned to mostly online learning during this time.

History of Technology in American Schools

Though computers, phones, and the internet are often at the forefront of peoples' minds when thinking about technology, many other tools existed before these inventions, making education more streamlined and accessible to students long before modern-day technology became widely available. An excerpt from a course taught by Dr. Maryanne Berry states, "Johannes Gutenberg began building a primitive version of the printing press in 1436, and the first Gutenberg Bible was printed in 1455 (de la Mare, 1997). Nearly two centuries later, Stephen Dayne brought the first printing press used in the United States (Rubinstein, 1999). However, since they were expensive and were not readily available, books were not commonly used in the early years of American schooling (Haran, 2015). Instead, early American teachers used what technology was available at the

time and continued to improve instructional tools as advancements were made in the field. Technology in American schools has evolved since settlers first arrived on the continent. From small one-room schoolhouses and minimal resources to large 1,000-student schools filled with gadgets and technology, schools have always had one goal: keeping up to meet their students' needs. Table 1 highlights some significant milestones in technological advancement that impacted schools. This table is not all-inclusive but provides a brief understanding of the timeline leading up to the present day.

Table 1

A Brief Overview of Technological Milestones in Education

Year	Technological Tool	Significance
Late 16th Century	Horn Book	The horn book was created to help children learn verses in their early school days. This tool often hung from children's belts and was used through the 18th century. (Britannica, 2017). Having this resource available increased the accessibility of education for children, as they now had something they could individually utilize in their practices.
1870	Magic Lantern	This resembled an early overhead projector and allowed teachers to show students images on the wall of the schoolhouse (Purdue Online, n.d.).
1890	Chalkboard	This innovation meant teachers could model lessons on the wall for all to see simultaneously and erase the writing for new lessons (Purdue Online, n.d.).
1920	Radio	Technology in warfare started to evolve, and with it came a push for scientific and mathematical improvements and exploration (Burton, 2020). 1920 saw the invention of the radio and the first on-air classes. In addition to providing benefits to farmers who could network, citizens who could now hear weather and critical alerts, and the military who could stay connected, this development also allowed learners to experience classroom lessons even if they were not near an educational institution (Saba, 2013).

1930	Overhead Projector	replaced the Magic Lantern, further improving existing technology and making it more interactive (Purdue Online, n.d.).
1950	Headphones	This made individual instruction easier and paved the way for Skinner's 1954 invention of the Skinner Teaching Machine (Purdue Online, n.d.).
1951	Videotape	This made individual instruction easier and paved the way for Skinner's 1954 invention of the Skinner Teaching Machine (Purdue Online, n.d.).
1954	Skinner Teaching Machine	This machine allowed students to learn individually through workbooks or using computers. When students got questions correct, they were rewarded. If questions were incorrect, students had to learn the material again and retry. This provided individualized instruction and met the needs of all students rather than a one-size-fits-all instruction method (Wleklinski, n.d.).
1959	Photocopier	Technology became more streamlined. Teachers could quickly reproduce materials, and students could calculate problems more rapidly. Education was becoming faster-paced (Purdue Online, n.d.).
1972	Personal Calculator	Technology became more streamlined. Teachers could quickly reproduce materials, and students could calculate problems more rapidly. Education was becoming faster-more paced (Purdue Online, n.d.).
1972	Scantron Machine	Technology became more streamlined. Teachers could quickly reproduce materials, and students could calculate problems more rapidly. Education was becoming more fast-paced (Purdue Online, n.d.).
1980s	Computers	In the 1980s, the first everyday use of computers became available, including the 1984 release of the Macintosh and the 1985 release of the Toshiba. In 1982, the computer was named the Time Magazine Man of the Year, recognizing its importance in evolving society and its significance in education (Purdue Online, n.d.).
1990	World Wide Web	Introduced in 1990, the World Wide Web became a household and educational staple in 1993 when the restrictions for commercial use were lifted (Purdue Online, n.d.).

1993	Personal Digital Assistants (PDA)	A handheld tool for learning and organization.
2000s	Social Media	The 2000s saw the creation of social media platforms such as MySpace (2003), Facebook (2004), and Twitter (2007), which allowed the everyday American to share thoughts and opinions over the internet. It also allowed teachers to reach families and learners (Jones, 2015).
2014	Google Classroom	Learning Management Systems (LMS) were created in 1990 and continued to evolve over the next three decades. In 2014, Google Classroom was created as an LMS. During the Global Coronavirus Pandemic from 2020-present, many LMSs have been used globally to educate students despite their physical removal from classrooms (eLearnHub, 2019).

Historically, in the eyes of the public stereotype, education looks like a teacher standing in the front of the room, writing on the board, and lecturing to students. This was sometimes all that was feasible in early education due to a lack of modern-day technology, and instruction had to be delivered in a central location, such as a chalkboard. However, in a 2017 literature review by Halman et al., the authors discuss the downfalls of this type of "banking" model of teaching, in which instructors pour information into the `heads of their learners in a teacher-focused environment, saying, "Freire's theory of critical consciousness critiqued the banking model of education, instead proposing transformative education through dialogue, and required a reflective awareness of and action upon societal conditions and inequities" (pg. 13). They went on to explain that for students to be successful, they must interact with the new knowledge through dialogue and meaningful practice. The influx of access to technology means more ability to promote an interactive and self-guided education for students. With technological tools in the classroom, educators can now provide many more pathways necessary to guide students' learning at their own pace and with almost limitless choices for demonstrating their new knowledge. This empowers learners of all backgrounds to achieve their highest level of ability because their instruction can be self-guided with the teacher's aide as a

coach. Additionally, students can interact with topics that interest them as learners, increasing motivation and excitement for learning (Kumpulainen & Kajamaa, 2020).

Covid-19 and The Need for Rapid Change

The Covid-19 Pandemic required the world of K-12 education to pivot overnight, with most learning environments needing to change their learning model immediately. The rapid onset of the pandemic forced educators worldwide to adapt lessons and instructional methods to a primarily online model. It thrusts even the most technologically delayed classrooms into a tech-forward setting. While most learning environments returned to operations as usual by the 2022-2023 school year, the changes in the use of technology in the educational setting are lasting, with devices in far more students' hands than ever before.

The federal and state governments stepped in to help schools adapt to online learning, with Minnesota implementing the CARES Act. The CARES Act "included an Education Stabilization Fund, which created two major sources of funding for schools: The Governor's Emergency Education Relief (GEER) Fund and the Elementary and Secondary School Emergency Relief (ESSER) Fund. It also contained section 5001, the Coronavirus Relief Fund (CRF), which established $150 billion in payments to state, local, and Tribal governments navigating the impact of the COVID-19 pandemic" (Minnesota Department of Education, 2022). With the help of this government funding, schools were able to provide devices for most students and help families access internet access ports at home or community hot-spot locations. Also, schools could purchase more technology platforms that students and staff could use to promote more individualized learning opportunities.

Gray and Lewis (2021) authored a report summarizing the results of a survey given to public schools in 2020, the year before the pandemic, called *Use of Educational Technology for Instruction*. Data from the 2020 survey found that only 45% of US schools provided each student with a computer. By 2023, survey data showed a significant increase in student-to-technology ratios. The Institute of Educational Sciences (2023),

of which NCES is a part, released survey data revealing that 94% of public schools now provide one-to-one technology for students. A significant factor in this increase was the shift to online learning. Reynolds and Dhawan (2022) state in their article that "daily usage of digital instructional materials has jumped from 28% prior to the pandemic's onset to 52% today" (p.1). The data shows that in the last three years, technology use in education has skyrocketed. This surprisingly fast acceleration of technology in education, after years of modest gains, has revealed both benefits and drawbacks to technology in elementary education.

The Benefits of Technology

Today's classrooms look drastically different than early American schoolhouses. It is common to see a laptop or tablet for every student, an interactive screen for teaching, and tools such as clickers, buzzers, or remotes for interactive learning, and this just includes the devices used for learning. These devices can help students utilize other technological advancements such as online learning management systems, educational gameplay for skill reinforcement, or programs designed to learn and adapt to each student's needs. Additionally, students can use technology to investigate, apply, and demonstrate content mastery on specific topics or standards.

Educators can show visual aids that were otherwise inaccessible to students through projectors or sharing websites on learning management systems. This allows students to "see" primary sources without traveling the globe. Classrooms worldwide can easily communicate through virtual meetings or electronic mail. Technology has opened doors of opportunity and simultaneously made the world much smaller. Modern-day technology brings the world to the fingertips of individual learners.

Online learning is one of the benefits of technology that emerged in force during the COVID-19 outbreak. Hongsuchon et al. (2022) define online learning as "…a method of distance learning using information technology infrastructures, including the use of digital applications, online learning software, and internet connectivity" (p. 2). Online learning can include fully

online classes (synchronous and asynchronous), flipped classrooms, and blended learning (part online/part in-person). Many countries implemented online learning classes for at least part of the year during COVID-19. Bailey and Lee (2020) found that an online teaching environment affords several benefits such as flexibility in learning, the ability to learn and study from different places, and it increased time for student responses. They also state that other benefits of online classes include increased student engagement, motivation, communication skills, and self-confidence. One technology tool that has seen a meteoric rise in the last few years is an online platform called Zoom, where students and teachers can see, hear, and communicate with each other. Correia et al. (2022) conducted a study of videoconferencing systems and choose Zoom, Skype, Microsoft Teams, and WhatsApp as the four most prevalent and widely used in the education world. Teachers see benefits from online classes such as increased flexibility, easier classroom management, ability to interact in a new way with students and families, and use of new or innovative technology (Nasution et al., 2022).

Augmented reality (AR) and virtual reality (VR) technologies are another benefit of the technological advancement that has occurred in education. Augmented reality (AR) and virtual reality were first used in higher education settings and later used in educational settings of younger children. An increase in VR usage in preschools and early elementary settings has occurred in the last few years. According to Aydogdu and Klepsiene (2021), “when augmented reality is used as a learning tool, it positively affects preschool children's levels of motivation, concentration of attention, knowledge, literacy, creativity and satisfaction” (p. 2). Researchers have found that VR and AR technologies are being developed and used in the following educational areas for younger learners: foreign language, early literacy, special, artistic, and musical skills (Aydogdu & Kelpsiene, 2021). VR has been widely used in the science field such as being able to virtually see and interact with the human body systems. There are virtual solar system programs where students can see the solar system up close and interact with it as they are learning (Putra & Pratiwi,

2020). Aydogdu and Klepsiene (2021) found that there are five advantages to using AR and VR in education: enhancing student motivation, social skills, and understanding, making learning more fun, and cultivating positive attitudes toward learning.

Another benefit of technology in education is the ability to provide personalized learning to students. Personalized learning is defined as instruction and objectives that are designed for each learner. Where the content can be tailored to their individual needs and interests (Xie et al. 2019). The researchers also found that students learn best when taught and supported at their own learning level. Due to technology, personalized or individualized learning experiences are now a scalable education strategy, instead of a technique used for a few outliner students. According to Twyman (2018), many technology tools and digital technology were created to help teachers personalize student instruction. Computer applications (apps) and software such as Seesaw, Nearpod, and Google Classrooms allow teachers to differentiate instruction and assignments by assessing student data. Other computer apps and software such as Prodigy, ABC Mouse, and EdPuzzle, provide personalized learning experiences without requiring teacher involvement. Learning apps give teachers a chance to differentiate learning for all students during independent learning times. Instead of every student getting the same worksheet, students can show their understanding of the taught skill through multiple platforms: drawing, a video, or audio speech explanation. Machine learning provides teachers with the advantage of using predictive modeling and adaptive learning. Predictive modeling helps educators track student performance and spot improvement areas while adaptive learning enables students to learn in a way that suits their unique needs and strengths to create a personalized learning experience for all students ("How Does Machine", 2023). A balanced use of technology in the classroom can foster a sense of belonging, accessibility, support, inspiration, interest, and self-control. (Bond et al., 2019).

Technology has supported the facilitation of communication and collaboration between students, parents, and faculty, a key dimension of successful elementary education. According to Bordalba, & Bochaca (2019) respect, trust, and

confidence between teachers and families is established when teachers give transparent and continual information about their student's education. Previous research has shown that parental involvement in a student's school life can have a significant impact on their academic success (Bordalba, & Bochaca, 2019). There are many technologies that teachers can use to facilitate communication with both parents and other teachers. Seesaw has an impressive communication system built into their software. Their online platform boasts that it "keeps everyone in the learning loop" with its inclusive communication tools for families, administration, and teachers. Within Seesaw teachers can send messages to individual students and parents or broadcast important updates to the entire class and all the parents. This software allows the teacher to communicate with voice and written messages. New applications such as Remind or TalkingPoints allow teachers to send reminder texts and updates to students and parents through a safe communication platform on their phones. A bonus is that many apps like this can also translate into the parents' language. Twyman (2018) found that teachers, parents, and students can connect and communicate easier with technology such as online grade books, class websites, and online office hours. Access to Zoom and Google Meet Zoom and Google Meet facilitates face to-face communication between families and schools.

There is one aspect of technology in elementary education that has been hotly debated by people around the world, artificial intelligence. Artificial Intelligence (AI) is one area that is currently exploding in the education field. There have been large investments in AI technology worldwide and in the United States, according to Holmes & Tuomi (2022) the United States invested over 94 billion dollars in 2021. The role of AI in education now and in the future is still being debated among teachers and administrators. ChatGPT is a new powerful open AI system that has brought the topic of AI in education to the forefront of conversation in 2023. Biswas (2023) states that "ChatGPT can support independent study, educators and students can use these technologies to enhance their own learning and development" (p. 1). The author claims that ChatGPT can be used as an effective educational tool in multiple

other ways. One example is to use AI or ChatGPT for tutoring and assistance with homework. Another example provided was to use it as a research assistant to help students search for relevant resources for papers and studies. Teachers can utilize this developing tool to assist in lesson planning, grading, and creating meaningful assessments (Jimenez & Boser, 2021). Whereas students can use AI to find resources and information about topics of interest or assist them with educational roadblocks as they work through problems and practice. Biswas (2023) also stated that AI could be used for paper reviewing, scheduling reminders, personalized learning, virtual office hours, and to help increase student engagement.

The Drawbacks of Technology

There are some notable areas for improvement when incorporating technology into learning environments. For instance, schools listed on the nation's high-poverty list may have fewer resources than schools where families are more affluent. This can significantly impact the accessibility of technology both in the classroom and in students' homes. While poverty arguably impacts a tremendous number of communities, some schools are finding ways to overcome the barriers, which can guide other schools to follow suit. Richard Kahlenberg wrote in an article for the American Federation of Teachers, "In 2000, the Conservative Heritage Foundation published a report, titled No Excuses, meant to show that high-poverty schools can work well. The forward of the report proudly declared that the author 'found not one or two ... [but] twenty-one high-performing, high-poverty schools.' Unfortunately, these 21 schools were dwarfed by the 7,000 high-poverty schools identified by the US Department of Education as low performing" (Kahlenberg, 2020). The issue of equity for students of lower socioeconomic status would be a crucial obstacle to overcome in any school's technology improvement plan.

The costs associated with bringing schools up to date with technology are also a barrier, even for schools in wealthy areas. Having devices in the hands of every student can be costly initially, and anytime something breaks, it is an added expense. Additionally, technology ages reasonably quickly and must be

replaced every few years to stay current. Districts will also need to consider employing more technology support professionals. These are all manageable if the school district prioritizes technology in their yearly budgets. Seeking out grants or government funding is also an option for many districts but may involve additional staff needing to be hired to take on these tasks.

In addition to equitable access and costs, another potential drawback is the training of educators. According to a recent study, the number one reason teachers resist incorporating new technologies into their classrooms is their fear of being able to understand and utilize them themselves. It is imperative to provide opportunities for teachers to be technologically literate to effectively integrate technology to enhance learning for all students without feeling overwhelmed or inadequate. Technology may not be used to its full capacity if teachers have an internal deficit mindset of their abilities in using the technology. (Harrell et al., 2018). Few people are familiar with the technology behind machine learning and artificial intelligence, despite being present in many areas of our lives, including education. Lack of understanding causes an overshadowing of its potential for positive impact (Marques et al., 2020). Many lack computer literacies and require more professional development (Ghory & Ghafory, 2021, p. 170). Purposeful and applicable training on each school's technology needs to be provided to teachers, and they need time to become proficient and comfortable. Doing so will increase the teacher's comfort level in utilizing the technology and their ability to teach their students how to use it to their advantage in their learning.

Another drawback of technology and digital technology is that it can perpetuate inequity in classrooms. Miller and Liu (2023) think of digital inequity as having three separate parts "(1) access to technology, (2) uses of technology, and (3) the outcomes of those uses" (p. 536). Their research showed that there is still an access gap between urban and suburban schools. That gap is mirrored in at home access to technology between students of color and white children. When looking at how different groups of students are directed to use technology in school, they found that students of color are usually tasked with

drill and practice of easy skills and white students are given high level tasks such as research and simulations. This troubling use of technology continues to compound the disparities and is a way that technology can increase inequities (Miller & Liu, 2023). In a report written by Facer and Selwyn (2021) they call the issues of low-income families not having access to the internet, computers, quiet spaces, and digital learning materials the "digital divide." The authors found in their study that only 12% of households in low-income countries have internet access in their homes. According to Facer and Selwyn (2021) the benefits of digital technologies as not evenly spread across all populations and such benefits are usually seen in educated, wealthy, motivated populations.

Elementary schools across the United States are increasingly incorporating technology into their curriculum, objectives, and goals (Lauricella et al., 2021). One of the issues with this is schools are not seeing a similar increase in Digital Literacy Classes and Digital Citizenship classes. Students need to learn new skills to help them traverse a tricky digital world. The International Society for Technology in Education (ISTE) claims that digital citizenship should be about the do's and not the don'ts. They believe digital citizenship should be taught in a positive way and should be balanced, informed, inclusive, engaged, and alert. In a study by Lauricella et al. (2021) they found an alarming amount, 40%, of K-2 teachers do not teach any digital citizenship skills. Digital citizenship is defined by James et al. (2019) as "the responsible use of technology to learn, create, and participate" (p. 13). In their survey of k-12 teachers they also found that only 60% of teachers use a digital citizenship curriculum and they only teach it monthly.

Widespread use of technology in classrooms has brought with it the challenge or downfall of off-task use, multitasking use, and student distraction. Schmidt (2020) found substantial evidence that when students multitask during schoolwork it can have a huge detrimental effect on academic success. Students can easily get distracted by the fun and entertaining options that technology can offer them such as games and social media like Instagram and Facebook (Pazilah, 2019). Multitasking can also be a cause of academic distraction as students try to accomplish

many tasks at one time. Dontre (2021) stated that it is common for students to have a computer with a large amount of browser tabs open at a time, as well as have a desk full of books, notebooks, and possibly even a cellphone. The author mentions that effective multitasking is a fallacy, and that research finds no academic achievement benefits to multitasking even with technology. Technology distraction in education is an important issue that needs to be studied to find ways to mitigate this technological downfall.

The downside to Artificial Intelligence in the educational setting is the potential for misuse of the technology. Automatic essay writing or paper writing is one part of AI that has particularly concerned teachers and administrators. AI platforms can write papers for students, and an increase in work submissions written by computers and not by students will likely increase. This hinders the learning process because teachers will not know if students truly understood the assessed standards or if they used AI to produce their final projects or assessments. Written essays are an important part of the educational curriculum around the world and with the newest AI technology it has become harder to determine if an assignment was written by a computer or a human student (Holmes & Tuomi, 2022). Yu (2023) reported that "the education industry must continuously innovate to adapt to the rapid development of technology" (p. 8). The future of AI and its role in education is uncertain although one thing is known, it is here to stay.

Conclusion

In conclusion, the benefits that technology offers education greatly outweigh the disadvantages. And one way to combat many of the disadvantages above is for schools and policymakers to continue to create ways to develop curriculum across the subjects that actively incorporate new and emerging technologies (Van Mechelen et al. 2022). Technology and education have always been entwined to help change the way teachers teach and students learn. By fostering a technology-forward, inquiry-based, creativity-driven learning environment, teachers are helping students to develop skills that will take society into the next generation. Educators have the

responsibility to keep up with the changes in technology to the best of their ability and to utilize it positively to promote equitable, meaningful, and exciting education, inspiring students to continue contributing to future innovations. In an article about modern-day technology use, the authors wrote, “The significance of technology in classrooms cannot be overstated. Indeed, the introduction of computers into education has made it simpler for instructors to transfer information and for pupils to retrieve it” (Ghory & Ghafory, 2021, p. 168). Now that the technology is there, it is the responsibility of educators to harness it for the greater good.

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Technology and Digital Citizenship: Civics Education for Modern Times

Jenna K. Ladd

Election workers in the 2022 mid-term election faced unprecedented harassment, threats, physical violence, stalking, and phishing attacks (Williams et al., 2022). “The threat was specifically that the following week that I would not be alive. And then my dog was poisoned,” elaborated one anonymous poll worker in an interview conducted by National Public Radio (Arnold, 2023). This surge in violent rhetoric and behavior was fueled by an online misinformation campaign alleging that there was widespread election fraud in the 2020 presidential election, although there is no evidence to support this claim (Eggers et al., 2021).

While the U.S. poll worker is an exemplar of traditional citizenship in practice, the actions of polling place agitators in 2022 demonstrate a need to empower the U.S. populace with knowledge and skills associated with a new kind of citizenship: Digital citizenship. The study and practice of digital citizenship is not only shaped by technological advancements; its existence is the result of the technological revolution. Advancements in technology have shaped the four areas of digital citizenship education: Ethics, Media & Information Literacy, Participation/Engagement, and Critical Resistance, in meaningful ways. However, education systems at all levels must continue to integrate digital citizenship curricula if students are to maximize the benefits and minimize the risks of living in a digital world.

Traditional Citizenship Education

Jenna K. Ladd

To understand the role that technology has played in creating the field of digital citizenship education, it is helpful to understand the history of traditional citizenship education in the United State s. The public education system was created because the nation's founders believed that an educated population was necessary for the preservation of the young democracy (Kober & Rentner, 2020). They believed that the general population must be educated enough to understand public issues, make informed choices when voting, participate in civic life, and recognize if domestic or foreign actors pose a threat to the nation (Kober & Rentner, 2020). These views emphasized the role of citizenship education creating and maintaining functioning democratic systems. Despite its decentralized model and the absence of a national curriculum, the public education system in the United States has generally served as a mechanism for cultivating citizenship skills in its pupils.

There has been considerable controversy, especially in recent years, about what it means to be an informed American citizen, and what and how students should be taught to be one (National Council for the Social Studies, 2021), but most can agree that the word citizenship implies membership in a community or nation that comes with a set of rights and responsibilities (Encyclopedia Brittanica, 2023). In the U.S., this means that citizens enjoy the right to free speech, own property, and to justice, for example, but they also assume some responsibility to civically engage through voting, volunteering, or petitioning (Knight Abowitz & Harnish, 2006). At the very least, they are expected not to engage

in activities considered treasonous or anti- democratic (USAGov, 2023). Therefore, an ideal citizen understands their rights, carries out civic responsibilities, and refrains from anti-democratic activity.

For most of the history of public education in the U.S., citizenship has been closely linked to physical location and real-world experience. A person's citizenship status is often determined by their geographic location. To begin, the acquisition of U.S. citizenship depends on whether someone was physically born in the country, born to parents who were, or have lived in the country long enough to be granted legal citizenship (U.S. Citizenship and Immigration Services, 2022). Similarly, many of the civic activities associated with being a "good" citizen often require one to be physically present, like serving on jury duty, voting in elections, and volunteering (Gramlich, 2019). Even the quality of traditional citizenship education a pupil receives depends largely on the school district they happen to live. For example, students at well-resourced public schools may enjoy higher quality civics and social studies courses and access to extracurricular activities that build democratic skills, like debate club. In contrast, students at under-resourced schools may not be able to develop civically due to lower quality social studies curriculum and the absence of robust extracurricular funding.

However, when personal computers and the Internet became widespread, citizenship status was defined by many factors, not only geographic location. About 50 percent of U.S. households reported having a computer in their home in 2000, and 40 percent reported having a connection to the World Wide Web (The New York Times, 2001). In 2018, the most recent year with nationwide data available, 92 percent of U.S. households had some kind of computer at home (United States Census Bureau). Similarly, 77 percent of U.S. households now have broadband internet access (Pew Research Center, 2022). This means that people can perform social, commercial, and

political activities online, and civic aptitude, or lack thereof, can also be demonstrated in virtual chatrooms and bulletin boards, in addition to brick-and-mortar community centers like schools, courthouses, and city hall.

Digital Citizenship

Ribble et al. (2004) first introduced digital citizenship as a necessary new area for educational research and practice in their article titled, *"Digital citizenship: Addressing appropriate technology behavior."* The article pointed out that guidance from the International Society for Technology at the time focused primarily on in-school student behavior using technology and did not address behaviors at home. Digital citizenship was defined as "the norms of behavior with regard to technology use" and broken down into the following nine areas: etiquette, communication, education, access, commerce, responsibility, rights, safety, and security (Ribble et al., 2004). As such, Ribble et al. proposed that educators prepare students to be upstanding citizens in a digital society at home and at school through digital citizenship education.

Since Ribble and colleagues first coined the term in 2004, the definition of digital citizenship has evolved beyond adherence to behavioral norms in digital spaces to include skillsets which empower users to create content and communities, engage in political activism, and curate unique online identities. This shift is best embodied by the work of Choi, who conducted a rigorous concept-analysis of digital citizenship to identify the major tenants of digital citizenship as presented in the research: Ethics, Media and Information Literacy (MIL), Participation/Engagement (P/E), and Critical Resistance (CR) (Choi, 2016). Despite the age of this study, the four components consistently demonstrate their reliability and validity in more recent studies related to digital citizenship (Dunaway & Macharia, 2021; Kara, 2018; Erdem et al., 2023). Thus, Choi's four element model is used as a framework for understanding how technological advancements have shaped digital citizenship education in the modern era.

Digital Citizenship Education and Technological Advancement

The relationship between digital citizenship education and advancements in technology is interdependent, cyclical, and ever evolving. Each of the four components of digital citizenship: Ethics, Media and Information Literacy (MIL), Participation/Engagement (P/E), and Critical Resistance (CR) (Choi, 2016) are necessary responses to advancements in technology. Continued curriculum development and teacher training must feature cross-curricula digital citizenship education to ensure that students are equipped vocationally, morally, and cognitively to traverse today's tech-heavy landscape.

Ethics and Technological Advancement

Ethics as they relate to digital citizenship can be considered at the macro (national, state government) level and at the individual level (Johri & Hingle, 2022). Either way, the rapid pace of digital development since the turn of the 21st century means that robust educational programs related to the new rights and responsibilities available to internet users are necessary. Using Choi's framework, three sub-categories of digital ethics are recognized: use of technology, digital awareness, and rights and responsibilities (2016).

The array of devices, applications, and digital tools available today means that young people are presented with options for digital engagement which can either cause harm, remain neutral, or perpetuate pro-social behavior. Deepfake technology, for example, can easily be weaponized or used pro-socially (McCallum, 2023; Lu & Chu, 2023). A quick Google search for "deepfake app" turns up advertisements for several free artificial intelligence applications which can produce fake videos of individuals doing and saying things they never did. This technology has been used to create deepfake pornography known as "revenge porn," which has become wildly popular online and can cause the victim psychological distress and threaten their ability to find and maintain employment (McCallum, 2023; Gieseke, 2020). As with all online content, these videos are often permanent and their effects long-lasting

(McCallum, 2023). Despite these impacts, the U.S. government trails behind other developed nations in criminalizing its creation (Weiss, 2023). The lack of action on digital ethics legislation by legislators makes it even more important that young people are taught to practice self-control and thoughtful decision-making around which technologies to utilize and when.

Awareness of technological tools is important to advance ethical practices in learning and research. One of those technological tools is digital twin technology. For example, a doctoral student in biomedical engineering could utilize digital twin technology to create a biomedical device in a virtual reality setting, try it out on digital patients, identify areas for improvement, and refine the device in preparation for real-world applications (Marr, 2022). Digital twin technology allows users to create "twin" virtual simulations of the real world, try things out, and adjust as needed without risking the safety of others or the environment (IBM, 2023). This technology is used widely in the healthcare, automotive, and manufacturing industries (IBM, 2023), but further digital citizenship training in the field of education is needed so that students and educators are digitally aware of its potential to improve research ethics.

The final component of ethics in digital citizenship education relates to rights and responsibilities: The right of individuals to have secure personal data and the responsibility to protect data security (Choi, 2016). This area of digital citizenship education emerged in part because students' academic lives are increasingly hybrid, and the line between the digital classroom and the real life-one continues to blur. Many sensitive data points related to students' education are now stored on the cloud, including assessment scores, medical records, and financial aid information. Understanding how to protect this sensitive information from data breaches is paramount. Students have the right to know what information about them is being collected, how it is protected and stored, and what it will be used for (Robert, 2022). Conversely, students are responsible for responding appropriately to phishing attempts, or correspondence pretending to be from official institutions to access sensitive information, and using secure account management practices, like two-step authentication and

remaining current on software updates (Klosowski, n.d.). Responsible account and data management is ethical online behavior because protecting one's own privacy also protects the privacy of others. Online predators who gain access to educational systems through the carelessness of one student may gain access to other students' personal information.

Media/Information Literacy and Technological Investment

Media/Information Literacy in the field of digital citizenship education is defined as "one's abilities to access, use, create, and evaluate information and to communicate with others online" (Choi, 2016). In a world where 25 percent of adults under 30 years old use TikTok as their source for news, it is important that students develop the ability to determine the trustworthiness of media, identify biases, and critically consider the source information (Matsa, 2022; von Gilleran et al., 2022). Research shows that many college students possess technology skills but lack the psychological capability and critical lens necessary to sift through misinformation (Hawamdeh et al., 2022; Wineberg et al., 2020). Young people's near-constant use of social media to access information makes them vulnerable to misinformation campaigns seeking to sew discord in the United States, such as Russia's attempt to influence U.S. elections.

The tendency for young people to access news and information on social media coupled with their struggle to discern fact from fiction further drives the spread of misinformation. In one study, researchers asked college students to assess the trustworthiness of a satirical news story and a website which billed itself as a non-partisan research group. Two-thirds of the respondents failed to identify that the news story was fake, and less than five percent of students identified that the research group website was created by a public relations firm (Wineberg et al., 2020). These findings suggest that although Media/Information Literacy are highlighted in the literature as key components of digital citizenship education, college students are not getting the instruction they need to be savvy consumers of media.

Still, the prepared digital citizen can do more than thoughtfully consume digital media, they can create it (The

Chronicle of Higher Education, 2023). Aside from preserving democratic ideals, it is the aim of most educational institutions to prepare students for professional careers. A recent study of job openings in the U.S. revealed that 92 percent required at least one digital skill (Bergson-Shilcock & Taylor, 2023). Chief among the digital skills in demand are those associated with production, like creating designs, editing video and sound, and writing code (The Chronicle of Higher Education, 2023). Modern media and information literacy also means that an individual can utilize newly developed artificial intelligence tools like ChatGPT and RowsAI thoughtfully. For example, the developed digital citizen understands how to properly input text and data to generate the most helpful results from these technologies, knows their limitations, and chooses to incorporate AI-generated content carefully, always citing it appropriately. Media and information literacy skills related to both consumption and creation of content are imperative not only to protect people and societies from the dangers of misinformation, but also to help students maximize technological skills to improve their occupational outlook.

Participation/Engagement and Technological Advancement

Technology has shaped human engagement in innumerable ways. The Participation/Engagement piece of the digital citizenship picture encompasses the cultural, political, economic, and social engagement activities of the person (Choi et al., 2017). To begin, social networking sites (SNS) have changed the way that young people engage with peers and how they develop their sense of identity (Ehmke, 2022; Uhls, Ellison, & Subrahmanyam, 2017). Social networking sites assist children and adolescents to complete developmental work like identity formation, aspirational development, and peer connection (Uhls, Ellison, & Subrahmanyam, 2017). Many teens reported feeling closer to friends and “happy” when interacting on SNS (Weinstein, 2018). The potential for social connection now extends across borders and time zones. Friends, families, and strangers can now message, engage in video calls, and interact via virtual reality from distinct places around the world and at any time of day or night. This development presents

opportunities to reduce feelings of social isolation, especially for marginalized groups like the elderly (Kusumota et al., 2022) or LGBTQIA+ folks (Chan et al., 2022), but social media sites can be addictive and present risks related online exploitation and bullying (Dahl & Bergmark, 2020). Thus, digital citizenship educators should help students learn to set appropriate boundaries around their privacy and time spent on devices to prevent problematic internet use.

In addition, technology has fundamentally changed how families and students interact with school districts and institutions of higher education. It is now the norm for individuals to register for courses, buy textbooks, pay education related bills, and communicate with teachers online. The migration of school related activities from in-person to online was accelerated by the COVID-19 pandemic (Bozkurt et al., 2022). Some students to lack the engagement skills needed to be successful online learners, like writing full, grammatically correct sentences in email correspondence or speaking to peers and instructors with respect, despite the distance and anonymity often provided by the internet (Minnesota State, 2023).

Technology allows individuals to connect with media that is relevant to their own cultural background, learn about others' cultures, and access artifacts and places of cultural significance globally that may not have been within reach prior to the digital revolution. First, video streaming services, video call platforms, and music streaming applications all offer ways for individuals who may be isolated from others with a similar cultural background or social identity to connect with culturally significant ceremonies, places, and loved ones from around the world. For example, immigrants living in the U.S. without documents report using video calls to "visit" their hometowns during the COVID-19 pandemic (Bastick & Mallet-Garcia, 2022). Similarly, digitization of art, music, and literature means that they can be distributed to larger audiences within seconds. Research from Wang (2021) found that traditional Chinese music, for example, has been preserved and is gaining international popularity thanks to online platforms like YouTube and TikTok.

Several culturally significant landmarks, museums, and national parks previously only available to those who had the money and free time to visit them can now be accessed by people around the world so long as they have a decent internet connection. Virtual reality has been outfitted to provide tours of world-renowned museums like the MoMA, the Louvre, and the British Museum in London (AR Post, 2023). Users can watch geysers erupt in Yellowstone National Park from the comfort of their homes or marvel as bears feast on salmon on one of three bear cams at Katmai National Park in Alaska from the safety of a classroom (Watson, 2023). These offerings mean that educators can not only engage learners in interactive learning about art, natural science and history, but they can facilitate their students gaining more familiarity with the latest digital tools, ultimately making them more aware as digital citizens.

Critical Resistance and Technological Advancement

Critical Resistance is the element of digital citizenship education that has been studied least (Choi, 2016), still, its practice is a direct result of advancements in technology, and most notably, social networking sites. While Participation/Engagement imply that the student is participating in existing systems to bring about positive change, Critical Resistance means that a person is creating new digital spaces or movements to critique or reimagine existing power structures (Choi, 2016). Research has demonstrated how social networking sites, like Twitter, can be leveraged in the classroom to allow students to practice engaging in respectful debate with those who have differing viewpoints and collaborate with those who share their beliefs to enact real world change (Gleason & von Gillern, 2018). This pedagogical approach boosts student engagement because it is centered around the student's values and interests and has also been shown to increase traditional literacy skills (McKenna, 2014, Gleason & von Gillern, 2018). Students who can practice skillful digital citizenship in Choi's first three components of digital citizenship might develop in the Critical Resistance domain by learning to think critically about the role that technology plays in our lives or employ technology to improve social systems in a meaningful way.

There are several recent examples of how technology has been used to engage in critical resistance to bring about pro-social change. These include #BlackLivesMatter, which called attention to police brutality, mandated the use of body cameras by law enforcement officers in many cities, and shifted white public opinion about officer related deaths (Ray, 2022) and #ALSIceBucketChallenge, which raised 41.8 million dollars for Amyotrophic Lateral Sclerosis research in 2014 (Hitching-Hales & Calderwood, 2017). The causes taken up by those engaged in critical resistance span the political spectrum and most Americans agree that online social movements can raise awareness, influence policy decisions, and change public opinion (Auxier & McClain, 2020). The digital progress of pro-social movements in the absence of national digital citizenship education effort speaks to the potential for positive change that could occur if students' Critical Resistance capacity was developed at school.

It is important, however, that Ethics and Media/Information Literacy skills are cultivated in equal measure with Critical Resistance skills to avoid social and political movements based on "alternative facts." As news sources have become decentralized and community-based, a lot of news media, which may include video or written work produced by official news organizations or citizen journalists, is now produced and consumed through social networking sites (Forman-Katz & Matsa, 2022). The ability for lay people to create bite-sized videos and tweets depicting local events as they unfold is positive in that it allows citizens to access news that may be less biased and more relevant than that which is produced by media giants (Common Sense Media, 2020). Still, TikToks, reels, and tweets spread like wildfire, often lack context, and are easily manipulated through deepfake technology (Common Sense Media, 2020). Thus, Critical Resistance should be developed in students only after they have shown competency in the first three areas of Choi's digital citizenship framework.

When disinformation becomes the basis for online and real-life social movements, the result can be dangerous. A striking example of this is the January 6 insurrection, in which at least 2,000 political demonstrators invaded the nation's capital,

threatened the lives of lawmakers, and sought to overturn the election, all based on the lie that the 2020 election was not valid (Offices of the United States Attorney, 2023). Similarly, thousands of families bucked vaccination recommendations after reading fake news that children died immediately after receiving COVID-19 vaccinations in West Africa; the article was shared 7,000 times on Facebook (Muhammed & Matthew, 2022). The limited research on Critical Resistance and technology suggests that these practices can be useful to boost student engagement, practice reading and writing, and promote pro-social change so long as they are paired with education about how to vet sources for veracity.

Conclusion

The public education system in the United States was created to empower the public with sufficient literacy, knowledge, and skills of discernment to engage in government processes (Kober & Rentner, 2020). This is achieved through explicit citizenship lessons in civics and social studies courses and through implicit socialization processes inherent to participation in democratic institutions (Vincze, 2023). In 2004, the digital revolution birthed a new field of citizenship education in response to students' new ability to connect socially online and access information on the world wide web (Ribble et al.). Since then, the field of digital citizenship education has continued to evolve in response to advancements in technology, but research suggests that educational institutions are not doing enough to shape youth into competent digital citizens (Dunaway & Macharia, 2021; Hawamdeh et al., 2022; Wineberg et al., 2020). New technology is developed every day. By 2030, it is expected that human-like artificial intelligence will exist and 3D-printed organs may be ready for transplant (British Broadcasting Corporation, 2023). These exciting advancements mean that educators at all levels and in all content areas must incorporate digital citizenship lessons into curriculum so that students can skillfully manage virtual hazards while using technology to engender pro-social change.

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Using Educational Traditions as a Lens for Exploring Artificial Intelligence in Education

Matt Howard

With so many changes occurring in education, many due to technological advancements like artificial intelligence (AI), it can be helpful to take a broad view. Rather than simply looking at individual cases, viewing these changes through the lens of different learning traditions or philosophies can offer some context to a complex set of issues. How an educational community adapts to emerging technologies should be reflective of the overall goals of education and must be viewed in a broad context. AI is likely to change education, as well as many other industries (Lund & Wang, 2023), as significantly as any technology before. We must therefore be thoughtful in our implementation of this powerful technology. As Hannele Niemi et al. (2023) write in the introduction to their book *AI in Learning: Designing the Future*, "The more AI is applied in education and learning, the more we need reflections on and solid grounds for ethical use of AI" (p. 6).

Educational philosophies provide grounding, whether consciously or unconsciously, for most decisions made in a classroom. Everything from what to teach, how to teach, how to assess, to classroom dynamics are tied to larger philosophical traditions (Beatty et al., 2009). Some traditions view education as a business, while others see it as a personal journey (Null, 2017). Some think a classroom should be reflective of the real world as it currently exists, while others think it should be training for creating a world that does not yet exist. How AI fits into education will be significantly influenced by beliefs about what education is and its fundamental goal. By viewing AI's implementation through the lens of four educational traditions (systematic, existentialism, radical, and pragmatic) many of its potential benefits to education, as well as concerns that arise, come into view.

The Systematic Tradition

No Child Left Behind (NCLB), signed into law in January 2002, ushered in a clear move towards a systematic approach to education (Null, 2017). NCLB focused on establishing a universal set of standards that each student would achieve, then holding students and schools accountable for achieving these standards through the use of high stakes tests (Finn Jr. & Hess, 2004). The systematic tradition views schools like businesses, whose goal is to effectively and efficiently produce finished products, in the form of graduates, that can seamlessly enter the workforce (Null, 2017). Viewed this way, schools would be foolish, if not negligent, if they did not use every tool at their disposal to maximize their productivity.

To a systematic theorist, AI provides incredible value. Many laborious and time-consuming tasks that are critical to a systematic approach, such as grading and providing feedback, can be offloaded to AI (Gillani et al., 2023). Since all students are working towards mastery of the same standards, AI can use large data sets to recognize trends and help guide students towards mastery. Beyond simply replacing tasks typically completed by a teacher, AI can improve upon what a teacher is capable of in many ways. Both feedback and assessment are critical components in the systematic tradition. At the end of a unit, teachers will often test students on their mastery of the topics covered, then provide feedback on each student's performance. The amount of feedback and the speed with which that feedback is provided is limited by many factors, such as class size and the amount of time a teacher allocates for grading. AI does not have these same limitations. AI can provide far more immediate and regular feedback. Rather than waiting for a test, AI "can support recursive feedback systems that are integral to learning itself" (Cope et al., 2021, p. 1233). This means AI can provide students with continuous, individualized feedback to help them achieve mastery of the pre-established objectives and standards. This type of immediate feedback is not limited to multiple choice or even written responses. A study conducted in a yoga class in Taiwan utilized AI to give feedback based on images of student poses (Hsia et al., 2023). Body posture

recognition technology was used to score student poses, which allowed students to reflect on this feedback in real time and improve their practices. After their four-week experiment, students who utilized the AI-assisted feedback system outperformed those in the control group on the skills measured in the study.

From a systematic viewpoint, there are few drawbacks and immense benefits from AI's use in education. If education is a machine, AI can upgrade that machine to run faster, smoother, and more efficiently. Schools and employers will have more data and therefore more certainty about the products that are leaving the schools and entering the workforce. If the goal of education is to plug finished products into jobs that help the economy, then the uniformity that AI can help provide will be a great asset that will undoubtedly have massive impacts on education. "To the extent that assessment drives institutionalized education, changes in assessment will change education" (Cope et al., 2021, p. 1241). This assessment to feedback loop is where AI will have its greatest impact in the systematic tradition of education.

The Existentialist Tradition

Many of the advantages of AI as viewed by the systematic tradition, are disadvantages when viewed in the existentialist tradition. Due to its automation, AI feedback, while fast and efficient, is inherently limited in scope. As Gillani et al. (2023) address when discussing the potential of AI tutors, they warn that AI tutors could place limitations on the scope of a class and on education itself. To an existentialist, education is a personal journey (Null, 2017), which requires autonomy for the student. This type of autonomy and freedom in education has a long history dating back as far as Plato's *The Republic* (Bonnett & Cuypers, 2003). Automation, standardization, and high stakes testing are antithetical to what existentialists view as important in education. "The existentialist sees the world in terms of personal subjectivity" (Emel, 2016, p. 1535). Personal subjectivity does not align with rigid standards.

This does not mean that existentialism and AI cannot coexist. Depending on how it is used, AI can potentially help

teachers in the existentialist tradition achieve their goals. With AI's capacity for giving individualized feedback, each student could conceivably receive a personally curated education that aligns with that student's interests and curiosities. This would allow classrooms to move away from everyone learning the same content on the same day and move towards the individualized education that an existentialist desires. That said, existentialist teachers would need to be careful with how AI is implemented. If AI is used to track students through their educational career, it may pigeon-hole students and inhibit personal exploration (Gillani et al., 2023). If students are tracked or deterred from taking certain classes due to recommendations from AI, this would work against an existentialist's goals.

Though the role of a teacher is more of a guide in the existentialist tradition, the relationship between teacher and student is still important. Can AI provide the same guidance as a human teacher? "The fundamental question for artificial intelligence is, how do binary calculations become human meaning" (Cope et al., 2021, p. 1230). Since the existential tradition places such an emphasis on human experience, removing the human is not a step that is taken lightly. It is likely that an existentialist would be more measured in their use of AI and proceed with more caution than someone from the systematic tradition.

The Radical Tradition

Perhaps the tradition that would look at AI with the most skepticism is the radical tradition (sometimes referred to as critical theory). The radical tradition sees education as an inherently political endeavor (Null, 2017). Radical theorists look at power structures and ask who holds power. Those in the radical tradition believe that those in power use societal structures to sustain that power (Beatty et al., 2009). Thus, the biggest question radical theorists would ask is, who controls these AI systems? If the answer is the wealthy, the powerful, or the elites, then this would be a concern to a radical theorist. If instead the answer is that everyone has equal access and equal

control, then perhaps it can be a tool used to solve larger societal issues and could ultimately be a force for good.

One of the biggest worries coming from the radical tradition would be the perpetuation of bias which could assist in maintaining an unequal status quo. AI is often trained on large data sets and uses something called machine learning. If these training sets include biased data, then what is a correlation due to bias will be seen as a causation, which could then perpetuate, or even exacerbate, societal issues (Gillani et al., 2023, p. 101). This is a microcosm of what the radical tradition is pushing against, i.e., the structures in place perpetuating the status quo. As an example, imagine AI is used to help students choose their classes for next year. Traditionally more male students take physics than female students (Decker & Daane, 2018). Machine learning is simply looking for patterns in the data, and when this pattern is seen, perhaps fewer female students will be placed in a physics class. This will continue the cycle of females being underrepresented in physics.

Returning to the discussion in the systematic tradition related to continuous feedback for students. This type of feedback can only occur if substantial data is collected. As companies compete against one another to build more powerful AI, they are using larger and larger data sets to train their AI (Bender et al., 2021). A radical theorist would ask who collects that data, who has access to it, and what is done with that data. Increased use of AI also raises issues related to climate change. Large language models (LLMs) consume vast amounts of energy, and schoolwide adoption may support systems that are detrimental to the environment. Determining AI's exact contribution to electrical consumption is difficult and estimates vary widely. More pessimistic assessments suggest that "Google's AI alone could consume as much electricity as a country such as Ireland (29.3 TWh per year)" (De Vries, 2023, p. 2192). While this estimate may be high, radical theorists must consider how large corporations and structures impact society as a whole. As Bender et al. (2021) put it:

> [I]ncreasing the environmental and financial costs of these models doubly punishes marginalized communities that are least likely to benefit from the progress achieved by large LMs and most likely to be harmed by negative environmental consequences of its resource consumption. (p. 610)

These large societal issues are a primary focus of the radical tradition and would therefore need to be addressed before radical practitioners could be on board with AI's adoption.

The Pragmatic Tradition

In many ways the pragmatic tradition parallels the current trends in AI. Many of the AI tools, such as Chat-GPT, are large language models that typically utilize deep learning (Lund & Wang, 2023). This deep learning uses neural networks that have a number of hidden layers, making only the inputs and outputs visible, with hidden connections made in between (IBM Data and AI Team, 2023). Similarly, the pragmatic tradition is primarily concerned with outcomes, rather than "ultimate goals or broad ideals… A good curriculum will only be known by the results it produces" (Null, 2016, p. 125). Just as a large language model utilizing deep learning can only be deemed successful by its output (the inner workings are opaque), a pragmatic view of education is based on how successfully it solves problems, not necessarily how it achieves the solution.

If AI is a useful tool for solving practical problems, and if students will use AI in the future, then these are good indications that those in the pragmatic tradition will support its use. The broader issues that concern the radical theorist, and to a lesser extent the existentialist, are not what is important to a pragmatist. If future employers will expect their employees to utilize AI as one of the tools at their disposal, then an education system should give students skills and experience using AI. To a pragmatist, schools should reflect the real world as much as possible, therefore the tools used by society should be the same as those used in the classroom.

Beyond the philosophical similarities between AI and pragmatism, AI can be used to solve many practical problems within a school. AI can play a role in solving problems as mundane as designing bus routes, up to consequential problems like counseling seniors as they prepare to graduate (Gillani et al., 2023). Schools are complex entities that have many logistical issues that must be solved. Tasks that must be done each year and have clear objectives can be completed by AI. Things get grayer in areas like counseling. But even counselors preform repetitive tasks, such as sending reminders to students, that could be assisted by, or completely taken over by, AI, which would be lauded by pragmatists.

Conflicts Between Traditions

Specific examples can help highlight differences between educational philosophies and their priorities. An instance where the pragmatic tradition may come into conflict with the radical tradition is when more complex and nuanced decisions are made regarding students. For instance, some schools have started using "early warning systems" to flag students at risk of failing or dropping out of school (Gillani et al., 2023). If this system successfully detects at risk students, then a pragmatist would deem this a success. The radical, however, would require a more nuanced answer. The AI system will not be 100% accurate, so a radical theorist will ask, which students is it missing, and more importantly, *why* is it missing *these* students. As Dwivedi et al. argue (2023), data is not without its biases. If already marginalized groups are disproportionately being flagged or missed due to previous practices, then this would raise the ire of radical theorists, who see this as a perpetuation of the inequities already present in our society. As the old saying goes, "garbage in, garbage out." If the data that the LLM is trained on has these biases built into it, rather than resolve the issue, it will only worsen it.

This highlights the importance of exploring the philosophical underpinnings of these issues. If ensuring that marginalized groups are protected is most important, as it is in the radical tradition, then significant effort must be put into

eliminating as much bias from the data as possible. If instead, as with the pragmatic tradition, the priority is having some system in place to start identifying students before they fail or drop out of school, then accepting a flawed system may be the result. Determining which is the best route requires a deep reflection of the priorities of the school and the community that it represents. These decisions will have to be made, so they may as well be made thoughtfully, and with an awareness of their philosophical underpinnings.

Conclusion

The question of AI in education is not whether AI will be present and impact education, but *how* it will impact education. Rather than standing by and seeing how it is pushed and implemented, those in the field of education should reflect on their priorities as educators and participate in shaping that future. If, like a systematic theorist, the highest priority is to help ensure that each student is leaving school knowing some base amount of information, then AI should be utilized as tutors and graders, helping students achieve mastery of important standards. If instead, like an existentialist, a student's personal journey is of paramount importance, then perhaps AI should be used in a more measured way, assisting students as they follow their passions and curiosities, but not replacing the personal relationship between a student and teacher. Even more caution must be used if concerns about power and overall societal good are the priority, as they are in the radical tradition. Like the proverbial spiderweb, each decision impacts the individual, the environment, and society at large, so caution must be used when viewed through the lens of the radical tradition. If instead of large issues, the concern is with immediate problems that are faced each day, then a pragmatic view of AI's use in education may be more appropriate. No single answer is necessarily correct, but if educators want to be a part of the decision-making process, then going all the way back to philosophical foundations would be a wise place to start.

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When disruptive technology disillusions educators: Considerations for professional learning to transform approaches to AI and machine learning.

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The information age has seen unprecedented growth in the amount of information people have access to as well as the pace at which innovation is adopted by society. This creates tension in long standing educational institutions to balance unknown future requirements for workforce and civic participation with current experiences of students currently in class, and the prior experiences of caregivers and community members. Expectations of effective educational experience differ based on the prior experiences of participants formed on hidden assumptions which may no longer best serve students currently in classroom. As technology drives disruption in society, the core student experience rarely keeps pace with the context of its learners. Technological advancement allows for increased knowledge gathering and collaborative learning which were not previously possible. Though innovation and accelerated improvement of hardware and software present challenges, the adults who support student learning need to recognize potential of tools teachers have had little to no practice using to learn. While the means through which students engage and achieve learning outcomes can be positively connected with swift adoption of technology, some shifts in long held thoughts of intelligence and learning require continual reassessment and research.

The surfacing tensions between expectations of innovation toward ill-defined future needs, community pressures, student interest and engagement, and caregiver experiences require many experienced educators to transform the premise that forms their applied assumptions to learning. Educational shifts to look past previous means

of educational transmission toward creating a new generation of learners require acknowledgement of cultural differences, updating their understanding of the process of learning, and incorporating the tools and skills which students will need to thrive in their unpredictable future (Gay, 2018). For these shifts to be made, education leaders and designers of professional learning need also to understand and allow for meaning making to be shifted or reinforced toward current understandings of future needs. To this end Transformative Learning (TL) (Mezirow, 2000) provides a framework for understanding phases of change in the premise or approach which forms the foundational meaning making and action stances of adults. "Transformative learning generally occurs when a person encounters a perspective or experiences an event that represents a disjuncture with their existing perspective… This discordant perspective/experience may be overlooked or it can provoke a disorienting dilemma that results in the examination of previously held beliefs, values, and assumptions." (Stuckey, et. al, 2022, Pg. 1460). The outward pressure of technological progress and the inward desire to support students to learn are often at odds with each other as new modes of learning, engagement, and production become possible. The initial stages of Mezirow's Transformative Learning (TL) framework disorientation and critical reflection (Ensign, 2019) represent critical steps that will help educators to carry through potential disillusionment toward a new premise of working with students to uncover learning.

Background: Technology adoption leaping forward

The reaction to OpenAI's viral release of a public, free to use, generative AI chatbot in the winter of 2022-2023 (OpenAI, 2022) has resurfaced conversation around assumptions on the baselines required for a quality

education. When a generative AI program can create coherent text out of a prompt, the underlying trustworthiness of submitted text is in question. Educators and publishers now wonder whether and how much of a text is human generated. As a primary purpose of writing is to communicate one's understanding, the knowledge of an author becomes more difficult to ascertain. Magana represents that current tools for communication and collaboration are important for authentic learning in that "Learners need to create connections between new information and their previously actualized knowledge base by interacting with that new information in meaningful ways within meaningful contexts." (2017, Pg. 6-7). For educators, this includes both identifying and connecting learning to authentic tools and means as they recognize and incorporate the cultural shifts which create that authenticity. Core assumptions about the nature and purpose of education need to be reassessed by teachers and education systems to provide a bedrock on which to adapt for the future of their occupation and the future in which students will need to be able to operate.

TL Phase 1: Disorienting Dilemma

As technology advances, repetitive and mundane tasks are often automated, and information is easier to access. Teachers who hold information as a status of their worth in a classroom may view this as a threat to their systems of approach to learning. A high speed of social adoption speeds the impact on classroom practices and may undermine long held assumptions of schooling requiring reconciliation of previously understood means of learning and new potential to apply understanding. Coupled with the exponential pace of change in technology, new means of establishing and reinforcing cultural capacity and knowledge are not always immediately seen. One characteristic of student

development is the establishment of identity within their own age group and with a larger community (Blakemore, 2018). Modern western expectations of the establishment of identity brings with it the requirement to connect with their peers and the larger world to create an individual yet social identity. This places great pressure on educators to balance between their own systems of making meaning surrounding learning, student needs for the creation and establishment of an individual identity, and the context of schooling bringing its own requirements for learning.

A disorientating dilemma as large as the public adoption of generative AI comes quickly on the heels of the COVID-19 pandemic. The shift to emergency distance learning forced a temporary transformation from well engrained in person models, to a narrow distance/remote learning models, to new means of hybrid/hyflex models, and then back to in-person models within the scope of a year and a half. Even though these were temporary and short term, "significant and irreversible changes have occurred in the way teachers experience and conceptualise their professional activity as well as carry it out in practice" (Goba-Medne, 2022, Pg. 481). These forced movement between three different educational modalities in place of learning placed immense stress on educators (Westphal, et al., 2022). Continued disruption in established means of learning and assessment forces new questions of teacher identity. How will teachers know students understand a concept if they can leverage an automatic essay? Westphal, et al. identified personality and self-efficacy as factors in burnout alongside COVID-19 vulnerabilty (2022) corresponding to a "discrepancy between the comprehension constructed through the former meaning perspective of an individual and its inability to sufficiently explain an experience" (Goba, 2019). As technology continues to provide immediate and expansive access to information at all times, educator's

experience in transmitting that knowledge seems less impactful leading to continued questions of educator identity.

TL Phase 2: A self examination with feelings of guilt, blame, or shame

As AI tools students have access to advance to near human performance, questions of the authenticity of a learning product to represent student knowledge is placed under question. While not the first generative AI tool available to the public, ChatGPT went viral in the winter of 2023. The initial reaction of disorientation leads often to a critical self-reflective stance. In terms of technological adoption, a negative reaction comes out of a sense that a teacher is the holder of knowledge filling the cup of the student. This loss of security in former order and conceptual rules developed through experience represents both internal and external conflict (Green & Malkki, 2017). Internally, the actions teachers have always relied upon seem no longer to represent student understanding. When an AI can pass high level exams to simulate the knowledge of lawyers, doctors, and even sommeliers (Varanasi, 2023), accreditations seem to be only worthwhile when a person watches another take the test.

As this disorientation continues, educator concerns over the validity of established common assessments reliant on low depth of knowledge responses and new means of access to those assessments grow. In the past few months, blame has been the primary approach. Students have been blamed for even considering using AI as their academic credibility is called into question (Carroll, 2023), and tools to detect AI writing lead educators to question academic integrity while detection tools deliver uneven results (Fowler, G. A., 2023). While using AI tools to complete assignments and assessment

has been reported by students, the numbers don't represent the amount of panic brought about by a new and difficult to understand technology (Welding, 2023). Though this process of critical self-examination isn't always negative. For instance fifty-one percent of educators acknowledged weekly use of ChatGPT or other AI (Impact Research, 2023) representing some vision for AI tool use in the classroom and some pathways to counter the fear of unknown processes and potential support. Supporting educators to positively engage in self-examination to deepen their practice, save time, and prepare students to focus on using innovation is an important element toward a positive transformative experience. For those educators concerned about academic integrity, reframing current practices to support students will be critical. Professional learning centered around positive responses include: increase the responsibility students take for dishonesty, communicate educator respect for students and pedagogical competence for the reason for learning, lessen the opportunity to be dishonest, and establish social norms for learning (Murdock, et al., 2008) to create an environment of trust and support.

TL Phase 3- A critical assessment of epistemic, sociocultural, or psychic assumptions

Accessing and efficient use of technology inclusive of generative AI is no longer a supplemental support to curriculum but an inherent element of society as a whole. Students need to develop capacities in digital learning to succeed in their future (OECD, 2022). While students who have grown up in an age of iPhones and wireless internet have some technical skills to browse for personal enjoyment, the assumption that they have the skills necessary for learning and productive interaction is incomplete (Janschitz, & Penker, 2022). Digital

citizenship, and use of electronic devices to learn need to be carefully developed to set a path for student success Sir Ken Robinson extended on common P21 skills of curiosity, creativity, communication, and collaboration (Trilling & Fadel, 2009) to add competencies of criticism, collaboration, compassion, composure, and citizenship (Robinson & Robinson, 2022) These additional elements represent the ever-expanding needs uncovered by society's interaction with technology.

The evolution of human interface with word processing is a direct example of these social norms. Kunde (1986) summarizes these experiences outlining at various times in history, the different processes possible with generating text. This technological experience places expectations on levels of direct human interaction in the process of generating text. Initial generation of writing required direct physical connection with the transcript. After the generation of a primary text, physical human transcription was required for maintenance or duplication. The technology of movable typeface required less physical interaction and increased output time once the intial text was created. Typewriters provided a faster means of generation of text and punch-coding allowed for key automation for typesetting removing much of the human interaction of generation and duplication of text. Computerized word processing alongside editing and printing tools and a myriad of innovations within programs, systems, and the introduction of cloud based computing further pushed the process of generation and publication away from direct physical human production. Along the way, these innovations have sparked both hope and fear of the impact of technology on the discipline of education and of cultivating educated minds. From Plato's relation of Socrates' concern that reliance on systems of writing will hinder both memory and full understanding of a concept (Plato, 2013) to Malesherbes' warning that the

printing press and getting news from a newspaper socially isolates readers (Bell, 2010). As technology evolves, so does the access and potential of the tools and knowledge available. As more information is available, the relationship between a learner and the knowledge required to be a learned member of society must undergo critical reflection.

Reassessing the assumptions of the relationship between a learner and the acquisition and recall of information requires uncovering and refining processes of thinking for effective learning. Educators who successfully navigate disorientation of the uncertain challenges, tools, and situations ahead, rely on futures literacy dispositions. Outlined as mindsets toward thinking about the potential of the future and shifting anticipatory assumptions to a conscious state of growth (Larsen, 2020). These dispositions of innovation, discovery, choice, leadership, strategy, agility, confidence, capability, knowing, and resilience represent successful thinking about the need to evolve practice and the premises which underline actions. This set of competencies describes an individual able to "detect and attribute meaning to novelty and complex emergence" (Ehresmann et al., 2018, Pg. 67) of the situations surrounding them. Futures literacy supports dispositions for individual visualization for the future to "move beyond a dependency on the illusion of certainty and the fragilities this creates" to "use-the-future more effectively and efficiently" (UNESCO, 2021). As educators encounter the disruption inherent in innovation in technology, they can come to terms by incorporating the unknown with their current understanding and experience. This futures literacy disposition focus may serve as an individual focus as districts move toward what is often referred to as the future ready skills movement.

Targeted directly to P-12 systems, the future ready skills movement is a focus of multiple initiatives dedicated to not just technology integration but also curriculum development. In looking toward the needs of the future; researchers, corporations, and the United States federal government have worked to define steps and stages for districts to apply. Three frameworks represent this development in supporting thinking outlined in Figure 1 below.

Table 1

Comparison of Future Ready Characteristics

P21 "Learning and Innovation Skills" (Trilling & Fadel, 2009)	**Hewlett Foundation "Deeper Learning" (2013)**	**"Future Ready Schools- Personalized Learning" (2015*)**
	Mastery of Core Academic Content	Using knowledge and information to solve complex problems
Critical Thinking	Critical Thinking and Problem Solving	Thinking Critically
Collaboration	Collaboration	Working Collaboratively
Communication	Communication in Writing and Speaking	Communicating effectively
Creativity	Self-Directed Learning	Learning how to learn
	Academic Mindset	Developing academic mindsets

These topics represent six years of response to initiatives and implementation of technology as educators an educational leaders work to distill the underlying skills students might need to develop as technology increasingly automates repetitive jobs. The availability and adoption of generative AI tools underscore the critical importance of deeper levels of learning and application of knowledge as technology increasingly is able to reach synthesis of disparate knowledge.

An update to the U.S. National Technology Plan is currently in development to further update suggested methods through which school districts design systems to prepare students for future success.

Educational leaders planning to support educators through this stage of meaning making should reconnect educators to key factors in their knowledge of practice. Darling-Hammond & Oakes (2019) suggest that uncovering these assumptions should touch on their knowledge of learners, their knowledge of the subject matter and skills, and their understanding of the actions of teaching or pedagogy. A reflective stand would do well to intentionally call teachers to other disruptions they have experienced as they incorporate Knowles' (2005) focus on the importance of adult experience in their learning.

The role of schools in the future: Future proofing a student's ability to learn:

Modeling lifelong learning through adoption, testing, and core competencies. Teachers need to be able to model processes of learning which expand past content knowledge. Uncovering these processes of learning will only strengthen both student and educator's abilities to respond to disruptions and the evolution of educational models and the needs of lifelong learning (Richards & Dede, 2020). This longer view of learning pushes past

individual classroom and teacher desires and represents the need to view the student experience and authenticity of learning from the eyes of the student working to interact with a society they have no control over as they continue to develop their own identities, interests, and potential impact.

Understanding and incorporating machine learning and AI will lead to programs which can individualize timing, content, and intervention of learning uncovering new understandings and pathways to reinforce the base elements of learning so important to opening pathways for new knowledge (Sejnowski, 2018). Additional focus on technologically durable elements of learning through AI interaction and learning how to learn represent current pathways to future proof student learning. The importance of a productive and supportive relationship between students and teachers is shown to have a major impact (Visible Learning Meta^{x}, 2023) on academic performance and growth. This is predicted to continue to be an essential element of learning and a characteristic of an AI proof occupation (OECD, 2022). Continuing to foster and better understand these relationships will be a necessity of the future of learning both for students and teachers as for those who support professional learning.

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Mentoring and Orientation for Nurse Educators: Technological and Innovative Approaches

Laura Beasley

The nursing shortage in the United States threatens the availability of nurse educators to teach in nursing education programs (Herleth et al., 2020). Nursing programs cannot enroll and graduate enough students to meet the current demand for nurses in various healthcare settings due to a nurse educator (NE) shortage. The retirement of NEs, salary disparities between nurses in practice and higher education, and a lack of mentoring and orientation after NEs are hired to teach in nursing programs are all contributing factors to the NE shortage (Ard & Beasley, 2022; Jeffers & Mariani, 2017; Swanson et al., 2017). To mitigate the problems associated with programs not being able to meet the nursing shortage's demands, the NE shortage must be addressed. One way to help alleviate the NE shortage is to provide NEs with support systems once they begin teaching in nursing programs. This could significantly increase the retention of NEs, thereby alleviating the shortage of them in nursing programs. Due to the NE shortage, there are not always enough NEs available to support newly-hired NEs. When resources are limited, technology and innovative approaches can help shape the future of NE orientation and mentoring. Using technology to bridge the gap between expert and novice NEs in practice can help foster a sense of collaboration and support that is often lacking when NEs begin their careers in academia.

Background of Problem

Struggle with Transition

Many nurses enter academia as expert practitioners and struggle to make the transition to education. Beacause this is their only point of reference, many of these new NEs teach in the manner in which they themselves were instructed, and as a result, they frequently struggle with utilizing newer evidence-based pedagogies to effectively instruct nursing students (Schroeder, 2021). At the same time, the student population

brings multiple generations into the same classroom, each with their own learning styles and needs. New NEs are frequently unprepared to address various learning styles, which can impact student learning.

Nurse educators can participate in various mentoring and orientation programs to acclimate to academia. However, depending on the availability of mentors, resources, and time, certain challenges remain. One area to investigate is the use of technology and innovative strategies to assist NEs in adjusting to their new roles in academia. Many aspects of the healthcare industry have been transformed by technology, and the impact on nursing education and practice is still evolving. Technology presents new opportunities and challenges in the context of how NEs can orient and mentor to their roles in academia.

Benefits of Mentoring in Nursing Education

Mentoring and nursing program-specific orientation can assist NEs in navigating their first few years of teaching, and it can help prepare the NEs for the role of preparing students for the challenges that await them once they enter the healthcare setting. Mentoring can set the NE up for success; it can help with the transition to academia and job satisfaction, which can help with retention; and it can positively affect program outcomes (Ard & Beasley, 2022).

Importance of Pedagogy

Teaching can be difficult, especially for new NEs. NEs must have pedagogical skills to prepare students for the rigorous nature of healthcare. Only 23% of newly graduated nursing students are prepared for entry-level practice (Kavanagh & Szweda, 2017). There is a lack of readiness due to a gap between theory and practice, and this is mostly due to inexperienced NEs teaching in nursing education (EL Hussein & Osuji, 2016). Unprepared for the demands of real-world care settings, new graduate nurses frequently feel overwhelmed and leave their jobs, resulting in a turnover rate of nearly 20% during the first year of employment, and only 23% have the competencies needed for success in practice (Stedman & Dabrow-Woods, 2020).

Unprepared for Teaching

To maintain the quality of nursing education and prepare nursing students for the increasing challenges they will face after graduation, NEs *must* be prepared to teach when hired. Oftentimes, nurse educators are hired right before the start of the semester, which leaves them little time to prepare a curriculum rigorous enough to meet the standards set forth by nursing programs to help students pass their NCLEX examination after graduation.

Often, NEs are thrown into the classroom, lab, and clinical settings with little guidance, which is chaotic and ultimately sets them up for failure (Shapiro, 2018). This is *one* of the reasons there is such a high turnover of NEs. In the "A Call for Nurses to Lead" section of the Future of Nursing 2010-2020 report (IOM, 2011), mentoring was identified as a responsibility experienced nurses should assume with less experienced peers. Mentoring was identified as a critical component of mitigating the loss of knowledge that occurs when nurses retire from the profession and new, less experienced faculty replace them in the most recent Future of Nursing (NASEM, 2021) report for 2020-2030.

Easing the Transition from Bedside to Academia

Helping NEs with the transition from bedside practice to nursing education through orientation and mentoring will help them create a supportive learning environment that will foster deeper learning for nursing students, and it will help NEs bridge the gap from theory to practice, enabling students to have a deeper learning experience. This will help nursing students be more prepared for practice when they are hired after graduation.

Expert NEs already teaching in the program are being taxed with increased responsibilities, requiring them to work understaffed in practice and instruction. This leaves little time for the seasoned nurse educator to mentor a NE just entering the profession of nursing education. These types of role strains have precipitated a crisis in the NE profession. Nursing programs must find creative ways to develop mentoring and orientation programs with the help of other NEs or find ways to collaborate

with nearby colleges and universities to manage resources more efficiently.

Nurse Educator Turnover

More NEs choose employment outside of nursing education than in the past and are less committed to the field (Morris, 2022). The shortage of NEs must be addressed to meet the current enrollment demands, which may eventually help the nursing shortage. To help decrease the role strain and turnover of NEs, nursing programs need to think of creative ways to improve orientation and mentoring processes. By leveraging technological tools and platforms, such as online modules, virtual simulations, multimedia and social media resources, robotics, and communication technologies, NEs can be introduced to their roles, responsibilities, and expectations dynamically and interactively. Technology and other innovative approaches have the potential to offer flexibility in terms of time and location, allowing new NEs to engage in orientation and mentoring activities at their own pace and convenience.

Mentoring and Orientation Models

While the literature acknowledges the effectiveness of mentoring and orientation in assisting NEs in adapting to their academic roles, it lacks specific information on how they are structured and implemented in nursing education. Regrettably, the literature provides little information on how mentorships should be structured. Nowell et al. (2017) conducted a study investigating some mentorship models, goals, and definitions. Their qualitative descriptive study included 48 nurse educators in Canada who participated in a mentorship model after they started teaching nursing education. They found that there were several different structures used, that included the following mentorship models:

- **Dyad:** This model was primarily informal, and when a new educator started, they were paired with another educator. There was no guidance on how it should be structured. This model occasionally uses co-teaching as a foundation for mentorship. This was also referred to as an *orientation* to their new role.

- **Peer:** Largely informal, peers or new educators with similar experience and rank came together to support one another in this model.
- **Group:** With little to no structure, several mentors supported a group of mentees in this model. This was frequently used in smaller institutions where faculty mentors were scarce.
- **Constellation:** The constellation model was created to match a mentee with multiple mentors. Based on their area of expertise, each mentor would meet the different needs of each mentee.
- **Distance:** In this model, mentees would seek mentors from other schools or disciplines. Email, video conferencing, and phone calls were used to facilitate communication.

Benefits and Limitations of the Mentorship Models

Participants in this study reported mixed reviews of their experiences with the mentorship models. Participants stated that most of the time, there was a lack of formality in each of the models presented and a hit-or-miss communication and mentoring relationship with their mentor. Some participants stated that they appreciated getting to know everyone and having help. The lines between mentoring and orientation were blurred for most participants in this study. One participant stated that if the orientation were unclear, mentoring would be useless because it would make no sense; forming those relationships in mentoring was most important to establish a foundation for knowledge sharing. Some participants formed meaningful relationships, and some did not work out because of personality issues. Some benefited from mentor and mentee training, while others did not. For some, the process of matching mentors and mentees appeared haphazard, with no clear reason why certain people were paired together. Still, others indicated that they appreciated having some support, even though it was not clearly structured. Finally, some participants stated that the mentorship model was not prioritized and that little was done to support a structured, purposeful mentorship model, depending on the institution's resources.

Quality clinical instruction is critical to developing skilled, knowledgeable nurses, and NEs are responsible for providing those students with those experiences. However, suppose a NE is unfamiliar with nursing education practices. In that case, the student may be unprepared for practice, resulting in unnecessary turnover for NEs in academia, which is already in short supply (Rodger, 2019). New technological advances and creative approaches to mentoring and orientation could be the keys to closing that gap.

Innovative Technology Strategies

A mentor's companionship is a valuable tool for retaining and supporting new NEs (Rodger, 2019). However, when access to mentors is limited, nursing programs must find ways to bridge the gap to retain their NEs and maintain program outcomes such as retention rates, graduation rates, NCLEX examination pass rates, and so on. Research is limited on the technological advances that can help bridge the gap for NEs that want to transition from bedside practice into academia. However, Rodger (2019) used a transformative approach to investigate how a nursing program with a high rate of NE turnover could assist in retaining clinical faculty who had previously left their positions because they felt isolated and unsupported. The participants in this study were clinical faculty who taught students in clinical agencies. The clinical faculty in this study stated that they were unprepared for the rigors of developing lesson plans, providing feedback, dealing with challenging students, and assessing their students and needed more assistance.

Robot Technology

In the study by Rodger (2019), four clinical faculty members—three of whom were brand-new to nursing education—received mentoring and orientation from robot technology while teaching groups of students in distant clinical agencies. Because these clinical faculty were not traditionally on campus where they could seek support and guidance from their peers, and the institution lacked the resources to provide them

with the personal mentoring and orientation required of clinical faculty, they devised this innovative idea to help bridge that gap.

The robot was stationed at the clinical site alongside the clinical faculty and students. The designated mentor communicated and interacted with the clinical faculty and students who were providing patient care using the robot. The robot would follow the clinical faculty and students as they went about their clinical day. The mentor in charge of the robot had access to everything the clinical faculty and students would have had if they had been present. As the day progressed, the mentor, through the use of the robot, was able to facilitate learning, provide feedback to students, assist clinical faculty with student assessments, and meet privately with clinical faculty and students as needed. All four clinical faculty members were polled and the results were positive. The clinical faculty expressed gratitude for the on-site assistance, saying it was preferred over sending an email and receiving a delayed response; the clinical faculty preferred immediate feedback, especially in times of trouble. They appreciated the on-site mentor, and their reliance on the robot lessened over time as they gained the experience needed to run the clinical experience effectively. As previously mentioned, the program studied had a lot of turnover in NEs, and 18 months after this study, all four clinical faculty remained in their positions.

Benefits and Limitations of Robotic Technology for Mentoring and Orientation

The robot was readily accepted by the clinical agency and helped to bridge the distance gap between the college campus, mentor, clinical sites, clinical faculty, and students. Some potential disadvantages included privacy issues within the clinical site with access to patient information, internet connections, and scheduling issues. Despite the challenges, the faculty and students in this study said it was worth it. Future research should be conducted in remote areas with more faculty in various settings, using robots for orientation and mentoring.

Nurse Educator: Transition from Bedside to Academia

A landmark study conducted by Patricia Benner in 2010 revealed many issues with the current system of nursing education and called for reform. She stated that nursing education has to do a better job of preparing nurses for practice because the patient of today is much more challenging and complicated than the patient of a few decades ago (Benner et al., 2010). As a result, nursing programs are challenged not only to develop a curriculum rigorous enough to ensure student success but also to find qualified nurse educators willing to take on that challenge with little preparation or knowledge of how to do so.

Not all nurse educators come to the table prepared to teach because they are not always taught about the best teaching practices when they obtain their graduate degrees. Using pedagogies that help students learn is the most effective way to help students develop a deep understanding of the material through student-centered approaches. There are many pedagogies available to use by nurse educators; the problem, however, is that NEs do not know or learn about them and are not always knowledgeable about how to deliver nursing education (Crider, 2022).

Faculty Navigator Program

To assist NEs in their transition, it is critical to provide them with the support and structure they need to be ready to train the next generation of nurses. Raymond et al. (2022) conducted a study using a faculty navigator program to help NEs adjust to their new roles. Faculty navigators, according to this study, are teaching and learning specialists who assist NEs in locating resources and fostering their professional development. The navigators accomplish this through individual consultation and professional communities. The navigation system was created to promote pedagogical development and empowerment, as well as to keep NEs from feeling isolated. The faculty feedback in this study was positive. They were able to learn pedagogical practices that would allow them to transition from bedside practice to teaching. They also learned effective assessment techniques. The navigators assisted in the coaching of the NEs and were available at all times for guidance, conflict resolution,

or simply to listen. The strategies used by the faculty navigator system helped the NEs gain confidence in their roles as NEs.

Benefits and Limitations of the Faculty Navigator Program

Participants reported gaining confidence in their teaching abilities and did not feel isolated in their new roles. Faculty navigators were always available by phone, email, or video conference and helped the NEs develop strategies for assessing their students and being better prepared to deal with student conflict. With the assistance of the faculty navigators, the NEs created learner-centered teaching strategies that can help students develop clinical judgment. One limitation of this type of mentoring is that study participants felt the faculty navigators were overworked. The faculty navigators had their own courses to teach, which added to their workload. The other NEs who worked in this program but were not in the study felt that the faculty navigators were so focused on the new NEs that they were forgotten regarding access to resources.

Social Media and Online Platforms

One of the significant benefits of technology for orientation and mentoring is the ability to provide consistent and standardized information to a geographically diverse group of individuals through online platforms. Online platforms and multimedia resources can ensure that all NEs receive the same foundational knowledge and resources, regardless of their physical location or the availability of experienced mentors. This promotes equity and consistency in the orientation and mentoring experience, enhancing the overall quality of education and support provided to new NEs.

Virtual communities, discussion forums, and social media platforms can connect new NEs with experienced mentors, allowing for the exchange of ideas, best practices, and ongoing support. These virtual interactions enable the creation of professional networks that extend beyond geographic boundaries, fostering a sense of belonging and community among NEs.

Many online platforms are available for educators to use for professional development activities, and those same

platforms can connect NEs with the tools they need to develop their skills and become better educators. The most frequently used tools by faculty in higher education are Facebook, Google+, ResearchGate, Academia.edu, and Twitter, according to a systematic review by Luo et al. (2020). These platforms include professional learning, peer-to-peer collaboration, and general information consumption beneficial to faculty development initiatives. This kind of learning and collaboration is gaining traction in various professional fields. Access to these platforms can be advantageous, particularly for busy educators.

Due to the influx of new NEs in nursing education, NurseTim Inc. developed an online four-week course for NEs to take in response to the demand for more tools to assist them. The course was created to assist NEs in adjusting to their new roles in higher education. The online course is taught by an experienced NE and includes recorded synchronous and asynchronous sessions. The course outcomes include learning how to develop relationships with students, create assessment tools, learn about legal issues in nursing education, and assist the NE in developing their role in practice (NurseTim, n.d.).

Benefits and Limitations of Online Learning Platforms

According to Luo et al. (2020), there are many benefits and limitations to consider when learning and collaborating with peers online. One of its benefits is the flexibility it offers. Educators can participate when it is convenient for them, at their own pace. Connecting with other educators around the globe can help foster collaboration and generate new ideas.
Sharing knowledge is also beneficial. Many of these online platforms that provide professional development, among other things, may not be regularly evaluated, and the platforms are controlled by users who may have a different perspective on what is discussed or taught and may lack relevant knowledge. When considering professional development opportunities, it is important to carefully evaluate the type of training and the organization providing it.

Conclusion

Innovative technology strategies provide promising solutions for bridging the gap and assisting NEs in transitioning from bedside practice to nursing education. The use of robotic technology can provide on-site mentoring and support in clinical agencies for NEs, which can lead to positive outcomes and increased NE retention. Additionally, faculty navigator programs have proven effective in helping NEs gain confidence in their teaching abilities and navigate their roles more successfully.

Online platforms, social media, and virtual communities provide flexible and accessible avenues for NEs to connect with experienced mentors, engage in professional development, and share knowledge. These technologies offer the potential for consistency in orientation and mentoring experiences regardless of geographical constraints, contributing to greater equity and quality of education for NEs. Despite the potential benefits of technology and innovative approaches, there are limitations to consider. Resource constraints and potential privacy issues with robotic technologies should be addressed before implementation. Additionally, ensuring the quality and relevance of online learning platforms is essential to the effectiveness of professional development opportunities.

Addressing the nursing educator shortage through technology-driven orientation and mentoring programs has great potential for empowering NEs, improving their pedagogical skills, and ultimately better preparing nursing students for the challenges of the healthcare profession. Nursing programs can nurture a new generation of skilled and confident NEs who will play a critical role in meeting the demands of nursing education and contributing to the future of healthcare.

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To AI or not to AI? How is Artificial Intelligence (AI) technology shaping the future of design studies, and what are the potential benefits and drawbacks of these technological advancements?

Danilo Lj. Bojic

Design education is tightly connected to technology and the rapid changes that are natural in the field. To stay current and relevant, design education and practice must critically analyze, evaluate and incorporate technological changes. Such as the emergence of artificial intelligence (AI), into educational curricula and pedagogy and into professional practice. Integrating AI tools effectively and practically within design education learning environments will empower students to enhance their creativity, accelerate ideation, and iterate more effectively. The integration must emphasize ethical considerations, such as responsible use, bias, and privacy, ensuring that students develop a core understanding of AI's implications in the field of design—academic and professional. By supporting an appreciation for AI as a powerful tool while reinforcing its role as a part of a more extensive creative process—and not the solution—educators can effectively prepare students for the ever-changing environment of design as a field.

Impact of AI on Design Education

Emerging technologies, such as AI, have a tremendous impact on design education, practice, research, and ethics by directly influencing the creative process. Current major AI technologies to consider include Dall-E, MidJourney, and Firefly. Dall-E generates images from textual descriptions, allowing students to explore different ideation paths visually based on conceptual descriptions

quickly (OpenAI, 2021). For instance, Dall-E may provide a range of design concepts based on provided descriptors creating a rich source of inspiration for further refinement. This could accelerate the ideation phase, enabling students to explore diverse possibilities efficiently. By integrating a tool such as Dall-E in the design learning environment, students could be equipped with a valuable tool to assist them in streamlining the early stages of project development. Meanwhile, MidJourney (MidJourney, 2022) uses AI to analyze existing design compositions and generate alternative versions, allowing students to conduct visual research by applying critical thinking and iteration. For instance, MidJourney offers data-driven suggestions on several design elements—such as typography, hierarchy systems, color pallets, grinds, and layouts—for improvement, fostering critical thinking and refining the design decision-making process. Additionally, Firefly, by providing instantaneous feedback based on AI analysis, assists students in refining their layouts, leading toward more polished creative outcomes (Adobe, 2023). By providing real-time feedback, Firefly enhances the learning experience and promotes iterative design practices.

The impact is mainly focused on the generative phase, and thus, it could be beneficial in the overall creative process. However, it is vital to keep in mind that the generative step represents just one aspect of the creative process. The current impact of AI on other phases, such as design thinking, critical evaluation, ideation, speculation, storytelling, and empathy, is somewhat limited due to the inability of AI to reproduce these inherently human-driven processes (Debergh et al., 2019). AI is another quantitative tool at the disposal of designers in the creative process rather than a qualitative solution in the process. Emphasizing AI technologies as tools in the creative

process needs to take precedence over viewing them as the ultimate solution of the creative process and as the result. These AI technologies can potentially transform traditional studio-type design education and how students learn, develop skills, and practice design principles by providing new learning opportunities and challenges in the process (Mustafa, 2023).

Integration of AI technologies in design education raises some essential considerations. The most dominant considerations are ethical in base. Intellectual property, copyright, plagiarism, consent, and privacy must be considered, as AI can generate assets that may resemble existing visual solutions or are based on them (Weale, 2023). The classroom needs to be a safe space to explore the appropriate and responsible use of AI while developing a complete understanding of the limitations of technologies and potential bias (Dickler et al., 2022). By enabling students to evaluate and responsibly utilize AI content critically, educators would equip emerging designers to ethically join the discipline's creative discourse. To successfully expand traditional design curricula to include AI technologies, educators need to integrate AI literacy as one of the pillars of digital literacy with a heavy focus on ethical considerations. Students would develop a foundational understanding of ever-changing AI technologies by introducing AI literacy into the learning environment, including its capabilities, limitations, and ethical considerations. By understanding how AI tools—such as Dall-E, MidJourney, and Firefly—operate, students will develop the necessary skills to apply them in their creative process effectively. AI literacy would foster collaboration, informed decision-making, integration of AI tools, and critical valuation of AI-generated content.

Educators, like with most technologies, guide and encourage students to explore different applications while considering appropriate use, intellectual property and copyright, and critical evaluation. AI has the potential to open new innovative avenues in pedagogy while acknowledging and reflecting upon ethics by assisting students in developing essential analytical skills that would support their professional careers and thus contribute to the current and future discourse on the ethical use of AI (Weale, 2023). By integrating ethical considerations into the creative process, educators, students, and professionals would ensure design inclusivity and user privacy protection and mitigate bias in AI-generated content. Furthermore, the structured use of AI could lead to evolution and changes in the assessment process by shifting the focus on thinking and ideas and less on technical skills (Dickler et al., 2022). Documentation of research and the developmental process of ideation might be integral for future academic integrity providing the necessary process and evidence for reflective evaluation. After all, design as a creative field is about generating ideas to address problems and pushing critical thinking further rather than perfecting technical execution.

We, as educators, play a critical role in encouraging students to use the acquired knowledge and understanding of cultural, economic, ethical, environmental, functional, political, and social issues to ask the AI the "right" questions to generate desirable outcomes envisioned by the user. Design education being student-centered, and design practice being human-centered, AI could be a powerful tool to support the generative process and further raise the reach of users' ideas. With practical hands-on projects integrating AI in the creative process, students would be provided with real-world experiences necessary as they emerge as future design professionals. Fostering a culture of critical thinking, creativity, and interdisciplinary collaboration through workshops, seminars, and industry partnerships

will help students develop the necessary skills to join the ever-changing professional landscape. It is critical for educators to help students develop the confidence to engage with AI technologies while maintaining independence and centering decision-making upon the designer. The impact of AI on design education is multifaceted, presenting both benefits and drawbacks that warrant careful consideration and navigation.

Benefits and Drawbacks of AI on Design Education

Some possible benefits of incorporating AI technologies into design education and practice include an increase in the speed of the design process as a whole providing designers with more leeway for daunting creativity and different ways of envisioning unknown visual and creative solutions (Dickler et al., 2022). AI has the potential to speed up the creative process allowing students to prototype more and progress to more options at a quicker pace, thus increasing the overall quality of the creative solutions and proposals (Rezk, 2023). By automating repetitive and time-consuming processes, AI may allow designers to focus further on ideation and push the boundaries of creativity (Tyson & Zysman, 2022). AI may be critical in streamlining the design workflow and thus raising overall productivity (Mustafa, 2023). The potential for creating new visual languages on its own is potentially fascinating for both education and practice.

The potential of shifting the creative process from manual work to predominantly or wholly mental might be a groundbreaking benefit of incorporating AI technologies. Instead of viewing AI technologies as ways to cheat and lower mental creativity, the opposite might be the case. By reducing time constraints of foundational levels of creativity, the higher potential would open for prototyping

explorations and refinements, leading to new forms of visual language and solutions (Lee & Cho, 2020). Furthermore, other types of AI could be used to predict patterns in user behaviors allowing designers to assess future user actions, needs, and preferences through accurate mass data analysis (Saeed, 2023). By leveraging AI, designers can strengthen the impact of their messages and products, enhance the user interface and experience, and extend the reach of evoking emotions.

Another potential benefit could be that AI might lower or remove barriers in design education and increase accessibility by shifting the focus away from the ability to do. It could be a pathway for more equitable design education and practice. As designers, we analyze, we deconstruct, we evaluate, and then we synthesize, and AI could be a helpful tool, like other creative software (Lee & Cho, 2020). Through the integration of AI into the curricula, our students will understand how to harness the potential AI brings and effectively use it in their future careers.

As people have biases, so do algorithms, and inherent prejudice remains a challenge requiring the designers to extensively test the tools they are using as well as the methods of interaction (Saeed, 2023). Critical thinking remains an important skill, if not the most important one, that educators must work with their students continually to develop. AI may open more space for such work and dialogue. Another drawback is the potential overreliance on AI tools in the creative process, thus seeing the generated results as the final step. Relying too much on AI solutions and suggestions could restrict individual exploration and experimentation potential. However, the most considerable drawback is connected to intellectual property rights. The final drawback is, as it is with all

technologies, the ability to effectively keep pace with rapid changes (Mustafa, 2023).

What is Next?

Design education faces similar changes to other disciples regarding emerging Artificial Intelligence (AI) technologies. In terms of design education AI in the form of image generation directly impacts creativity, ethics, and the future of potential professional careers. However, good use of AI in design heavily relies on critical skills firmly grounded in visual literacy, design knowledge, practice, and understanding. Irreplaceable human qualities that AI cannot emulate require consideration as well as appreciation. As design traditionally embraces technological changes that are rapid in nature, it could incorporate AI technologies in a similar fashion to significant software changes pushing design from purely analog to digital and hybrid. Essentially AI is another creative tool at the disposal of designers fitting under the appropriate use ratio as many other creative technological tools fall under. The changes that AI technologies could bring might be transformative to design education and practice by shifting the focus from doing and thinking to channeling raw creativity. With careful incorporation of AI tools into design education curricula and pedagogy while preserving and protecting the essence of human creativity and empathy, design education can empower students to become versatile and ethically responsible creators, ready to embrace the opportunities AI brings to the future of design as a field.

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Game changers: How emerging technologies impact digital game-based learning (DGBL)

Sadie R. Gunnink

Digital Games in Education

In the modern era of education, the traditional boundaries of learning are being redefined, with digital game-based learning (DGBL) emerging as a powerful tool to engage and educate students. As of 2021, the EdTech market was valued at $254.8 billion and is expected to reach $605.4 billion by 2027. A subset within EdTech, DGBL, is expected to grow to $9.03 billion from 2020 to 2025 (Baruffati, 2023). However, DGBL does not exist in isolation; it is influenced and shaped by many emerging technologies that continue to revolutionize the educational landscape. As highlighted in the upcoming text, some of these technologies have been part of daily life for decades. However, recent media attention has brought them into the limelight as catalysts of change. By exploring the interconnected relationship between emerging technologies like virtual reality, artificial intelligence, adaptive learning, and DGBL, invaluable insights are learned about the crucial role technology plays in DGBL and how technology unlocks the potential of play, leading to a profound impact on student learning outcomes.

Emerging Technologies in the Context of Digital Games in Education

Various emerging technologies have significantly influenced the development and utilization of digital games in classrooms worldwide. Some of these technologies have a long history; however, their impact on digital game-based learning has only recently become more pronounced. An example of this is computers. Barfield (2020) outlines the progression of computers, beginning with the first mechanical (not electrical) computer in 200 BC – 70 AD, then the term "computor," emerging in 1613, referring to individuals performing numerical computations. However, it was not until 1822 that Charles Babbage conceptualized a design for a computer resembling

modern-day computers, and it took until 1991 for a working replica to be built at the British Science Museum. (Barfield, 2020) This example illustrates how technological advancements often involve a considerable time gap between the initial concept and its widespread adoption. Several emerging technologies shown in Figure 1 have experienced similar trajectories, with ideas and prototypes taking years to gain traction and becoming accessible to the masses.

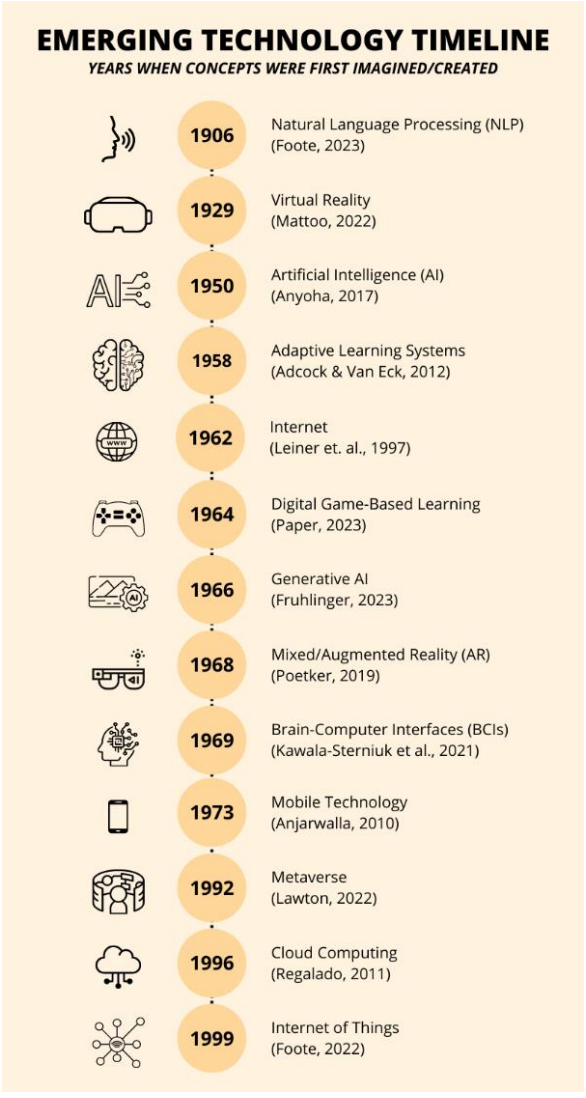
Natural Language Processing (NLP) – circa 1906

In 1906, Swiss linguistics professor Ferdinand de Saussure began teaching courses on "Language as a Science." He taught the approach that languages were "systems" that could be reduced to sounds that represented concepts that make communication possible. (Foote, 2023) This early work laid the foundation for Natural Language Processing (NLP). NLP allows computers to use and understand human languages. In digital game-based learning, NLP could be used for voice recognition and natural language understanding within the game interface, allowing players to communicate with virtual characters, solve puzzles through dialogue, or receive real-time feedback using spoken or written language.

Zhang (2021) is a data scientist who describes himself as an immigrant who had a tough time playing English word games due to his limited English vocabulary and cultural background. He compared NLP systems, word2vec, and GPT-3 in their ability to help him play the game "Blather 'Round" to increase his chances of winning and understanding the words and examples given when playing. He found GPT-3 the most robust and correct at the time. Another example is the Google Experiment game "Mystery Animal." While the game is no longer active because the experiment has ended, it allowed players to interact with the AI and ask questions while trying to guess which animal the AI was supposed to be. (He & Jonas, 2017) Based on these examples, NLP is a good fit for digital game-based language learning.

Figure 1

Timeline of emerging technologies from 1906 to 1999



Virtual Reality (VR) – circa 1929

Virtual reality (VR) technology creates fully immersive virtual environments that simulate real or imaginary worlds. The first example of VR happened in 1929 when Edwin A. Link invented a flight simulator called the Link Trainer to instruct pilots about dangerous flying conditions. (Mattoo, 2022) However, the term "virtual reality" was not coined until 1987 by Jaron Lanier. (Mattoo, 2022) Like the students riding on the 1994-1997 animated series "Magic School Bus" (IMDb, 2004), today's students can use virtual reality to be transported to historical landmarks, distant planets, or even microscopic worlds via virtual learning environments, enabling them to explore, interact, and solve problems in a three-dimensional and immersive setting.

Artificial Intelligence (AI) – circa 1950

Artificial intelligence (AI) involves the development of computer systems that can perform tasks that typically require human intelligence. It started in 1950 when Alan Turing, a young polymath, asked the question, "Can machines think?" (Anyoha, 2017) The first AI program was subsequently invented in 1955, but as AI grew in capability over the years, the hardware technology could not keep up. Hence, the technology stalled from the late 1970s until the hardware issues were resolved in the 1990s and 2000s. (Anyoha, 2017) Today, AI is utilized in several ways, from facial recognition to grammar assistance, as well as lane assist and driverless cars to deciphering large data sets.

AI is already a part of education. For instance, MathSpring is an online math tutor that helps tutor math students. (MathSpring, 2023) In the context of DGBL, AI can create intelligent virtual characters, develop adaptive gameplay experiences, provide realistic and challenging opponents, and offer personalized feedback to players based on their performance and behavior.

Adaptive Learning Systems – circa 1958

Adaptive learning is an instructional methodology that begins with a baseline assessment to determine a learner's level

of understanding and then adjusts the instruction content accordingly. The concept began when B.F. Skinner introduced his teaching machine in 1958. This learning machine presented 30 questions on a 12-inch disk. The learner interacted with the machine to answer each question, shown one frame at a time. The manual machine presented each question and allowed learners to continue taking the assessment until all questions were answered correctly. (Skinner, 1958)

Adaptive learning systems of today use digital data analytics and algorithms to personalize the learning experience based on individual student needs. In a DGBL environment, adaptive learning systems can dynamically adjust game content, difficulty, or feedback based on the player's progress, ensuring a tailored and optimal learning experience. For example, if a player of a digital game with adaptive learning finds the game's initial levels quite easy since they already have a strong grasp of the content, the adaptive system quickly assesses their knowledge and skill level and adjusts the game content to offer more challenging content and questions for that player. According to Common Sense Education (2022), some of the best adaptive math learning games to date are DoodleMaths, Happy Numbers, LearnBob, Prodigy Math, and others.

Internet – circa 1962

As Leiner et al. (1997) explain, the internet concept was first documented by J.C.R. Licklider of MIT in 1962. Licklider's initial vision, combined with the work of Leonard Kleinrock on packet switching theory, the connection of four host computers, and a handful of other researchers testing and refining, brought the internet into being by the end of 1969. The internet has been the most transformative and well-adopted of the listed emerging technologies in this paper.

The internet has catalyzed the rapid growth and expansion of digital games in the classroom. With its vast connectivity and accessibility, the Internet enables seamless access to various educational games, resources, and platforms. It provides a global network that connects students and educators, fostering collaboration, communication, and knowledge-sharing. According to NCES (2021), 88% of U.S. children had home

internet access through a computer during the pandemic. Through online gaming platforms and communities, students can engage in multiplayer games, solving problems together, and learning from one another.

Digital Game-Based Learning (DGBL) – circa 1964

Paper (2023) reported that the first-ever educational computer game, The Sumerian Game, was designed by Mabel Addis and released in 1964 as a part of a study featured in *Computerworld* magazine. The ever-popular game "The Oregon Trail" was released in 1971 and is still used in classrooms today! A study by Murray (2012) identified that 8% of U.S. teachers were unsure if DGBL was necessary for the classroom, 38% thought game-based learning was needed, and 54% thought game-based learning was a must-have. A later study by Baruffati (2023) reported that 58% of teachers' opinions of game-based learning had improved since 2020 (the COVID-19 pandemic), and Pinder (2021) reports that 90% of teachers surveyed expressed positive feelings towards game-based learning. The growth and use of DGBL shows no sign of slowing down.

Generative AI – circa 1966

Generative AI is a form of artificial intelligence that can produce, manipulate, and synthesize data to create something that never existed before. (Fruhlinger, 2023) This could be text, graphics, computer code, and more. MIT created the first generative AI when they created ELIZA in 1966. It was a chatbot that simulated talking with a therapist. (Fruhlinger, 2023)

Generative AI can create dynamic and procedurally generated game content, such as levels, characters, graphics, and narratives, providing players with endless possibilities and unique experiences. Gwertzman et al. (2022) claim that games will be the most impacted by Generative AI. The example they give of Microsoft Flight Simulator makes it easy to see why. Microsoft used Generative AI to create 3D photorealistic imagery from 2D satellite images. Now, when student pilots and aviation aficionados practice flying their virtual plane to exotic locations halfway around the world they have never been to, they will get a life-like experience on screen.

Mixed /Augmented Reality (AR) – circa 1968

Mixed or Augmented reality (AR) differs from VR in that VR immerses a learner into an environment completely different from the one they are in. AR blends virtual and real-world elements, enhancing the player's perception and interaction with their environment. Harvard professor and scientist Ivan Sutherland created the first AR headset in 1968. (Poetker, 2019) The term 'augmented reality' was coined by a Boeing researcher, Tom Caudell, in 1990. (Poetker, 2019)

AR has been used for corporate education, education, and military training. In DGBL, AR can overlay virtual objects onto the real world, allowing students to interact with educational content more engagingly and interactively. Eastern Peak (2023) gives several good examples of AR learning games already in play: Catchy Words AR (like PokemonGo, but with words), NarratorAR (teaches 3-5-year-olds to write), Skin and Bone (allows Smithsonian visitors to interact with exhibits), and more.

Brain-Computer Interfaces (BCIs) – circa 1969

Brain-Computer Interfaces (BCIs) are just what they sound like. BCIs establish a direct communication pathway between the brain and external devices. The first BCIs were tested on monkeys in a UCLA lab in 1969 and 1970 and then in humans in the 1990s. (Kawala-Sterniuk et al., 2021) BCIs are currently used in the medical community, focusing on hearing (cochlear implants) and people with spinal injuries recovering lost body function. However, BCIs can also be found in gaming and computing.

In gaming, BCIs can enable players to control game elements using their brain signals, enhancing the immersive and interactive nature of the gaming experience. The first example of this was in 2003 when Philip Kennedy introduced the first BCI game, "BrainGate." (Kawala-Sterniuk et al., 2021) In computing, most recently, Elon Musk has made the news with his company Neuralink, which intends to implant a chip into a human that will allow the subject to control a computer with a mere thought. (Das, 2022) This has far-reaching implications for learners directly interacting with their DGBL.

Mobile Technology – circa 1973

Martin Cooper of Motorola made history on the sidewalk in New York outside his office building when he made the first public cell phone call in 1973, allegedly to his competitor, Joel Engel at AT&T, to inform him of Motorola's breakthrough. (Anjarwalla, 2010) Since its inception, mobile technology, such as smartphones and tablets, has offered portability and accessibility for all kinds of digital media. The number of people that play games on their mobile devices has risen to three billion (Geyser, 2022). Baruffati (2023) reported 74% of online college students said they wanted mobile access to their course materials, and 6% of children ages 3-18 only had access to the internet through a smartphone during the pandemic. Mobile technology has become a staple and is ever important in DGBL.

Mobile games can provide on-the-go learning opportunities and foster engagement inside and outside the classroom, as evidenced by Duolingo. Duolingo is a learning game created to help students learn a new language in an engaging, self-paced way. "During the first quarter of 2023, Duolingo had approximately 72.6 million monthly active users of the app, up by around 20 percent compared to the fourth quarter of 2022." (Ceci, 2023) These impressive numbers illustrate how successful mobile technology is in the DGBL realm.

Metaverse – circa 1992

The metaverse represents a virtual shared space combining augmented reality, virtual reality, and the internet to create a rich and immersive digital environment. According to Lawton (2022), it is still largely unbuilt, and multiple versions are circulating. Reed (2022) describes *Second Life*, launched in 2003, as the first known metaverse where people could choose an avatar and interact with other players. Most recently, Facebook renamed itself Meta and launched its own version of a metaverse experience. However, if would like more information or an example of what it could be, the book *Snow Crash* by Neal Stephenson (1993) is the first to coin the phrase metaverse and

describes the story of what it is. *Ready Player One* by Ernest Cline (2011) is another book that describes the possibilities.

In the context of digital games in the classroom, the metaverse opens exciting possibilities for collaborative and interactive learning experiences. It offers a dynamic platform where students can engage with educational content, interact with virtual objects and characters, and collaborate with peers in real-time, transcending the limitations of physical classrooms and breaking down geographical barriers. By leveraging the metaverse, educators can design immersive learning environments that simulate real-world scenarios, foster creativity, and problem-solving skills, and enable students to explore and experiment in a safe, controlled virtual space. As the metaverse continues to evolve and mature, its potential for transforming the digital game-based learning landscape is high.

Cloud Computing – circa 1996

In 1996 George Favaloro of Compaq and Sean O'Sullivan of NetCentric sat in a Compaq company office and started laying out the vision for cloud computing. O'Sullivan filed for a trademark on the term in 1997, but it was never approved, and the project with Compaq fizzled. (Regalado, 2011) However, in the visionary plans O'Sullivan provided, his vision was exactly what is seen today; cloud computing enabling the storage, access, and sharing of digital game resources and data on remote servers via the internet.

Cloud computing provides scalability, flexibility, and collaboration opportunities, which in turn allow students and educators to access and collaborate in DGBL from anywhere, fostering remote learning and teamwork. Examples of cloud-based game-based learning platforms are EdApp, Kahoot, Gametize, Centrical, Archy Learning, and more. (Bariuad, 2022)

Internet of Things (IoT) – circa 1999

Kevin Ashton, MIT Executive Director of Auto-ID labs, coined the term in 1999. "Simply stated, the Internet of Things (IoT) consists of any device with an on/off switch that is connected to the Internet." (Foote, 2022) This includes physical devices embedded with sensors and software that can communicate and exchange data, such as modern smart

appliances, agriculture equipment, cars, watches, security systems, etc. (Thomas, 2022)

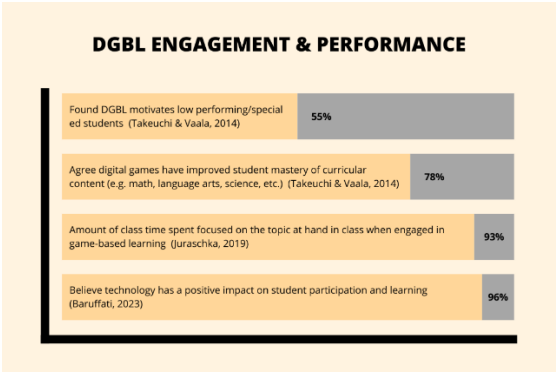
In digital game-based learning, IoT can enhance gameplay experiences by connecting physical objects, such as game controllers (wearables) or smart objects, to the virtual game world, creating interactive and immersive scenarios. For example, students can learn the games Cricket, Tennis, Bowling, etc., using wearable controllers (IoT items) and following the prompts on a screen (Muskan, 2021).

Benefits and Efficacy of Digital Game-Based Learning (DGBL)

By leveraging the collective power of these emerging technologies, digital game-based learning (DGBL) brings forth many interconnected benefits that enhance student engagement and foster personalized learning experiences while expanding educational opportunities. Extensive research has been dedicated to exploring the advantages of DGBL, and the findings unequivocally demonstrate its impact. For instance, Figure 2 illustrates the compelling results: 55% of surveyed teachers reported increased motivation in low-performing and special education students (Takeuchi & Vaala, 2014), while an overwhelming 78% agreed that digital games improved students' mastery of curricular content, spanning various subjects such as math, language arts, and science (Takeuchi & Vaala, 2014). Furthermore, empirical evidence reveals that students immersed in game-based learning remain focused a staggering 93% of the time (Juraschka, 2019), solidifying the effectiveness of DGBL in sustaining student attention. Moreover, an impressive 96% of surveyed teachers expressed their belief in the positive impact of technology on student participation and overall learning outcomes (Baruffati, 2023). These statistics underscore the transformative potential of DGBL and its ability to drive enhanced student engagement and achievement.

Figure 2

Digital Game-Based Learning (DGBL) engagement and performance statistics



Drawbacks and Ethical Concerns

While emerging technologies offer numerous benefits in the realm of DGBL, it is crucial to address the accompanying drawbacks and ethical concerns that warrant careful consideration. Privacy and data security is one of those issues. The use of emerging technologies in digital games raises concerns about collecting, storing, and using personal data, necessitating robust privacy safeguards to protect students' information and ensure data security. To protect data and privacy, Kaspersky (2023) suggests setting strong passwords, using multi-factor authentication, only downloading games from legitimate sources, and installing and using a virtual private network (VPN).

Another area of concern is the inequality of access to technology. As highlighted by Baruffati (2023), 63% of American students use laptops in the classroom, however, according to research done by the Pew Research Center (2021), 43% of Americans lack household internet, and 41% do not have a desktop or laptop. These factors make information access at home more difficult and less accessible for learners living in those households. Further, the cost of VR headsets, as pointed out by Afolabi (2023), renders them inaccessible for many

students, while those with sensory or physical disabilities may experience adverse effects like nausea and vomiting, making VR headsets an impractical option.

While DGBL holds significant potential, its effectiveness is severely limited if students cannot access and benefit from it. Also, teachers' frustrations with technology in the classroom, leading to distraction and increased troubleshooting time, as reported by Azad (2023) and Baruffati (2023), further underscore the importance of addressing the concerns of integrating technology in the curricula to ensure equitable and meaningful implementation of technology in education.

Impact on Classroom Practices and Further Research Needed

The integration of digital game-based learning (DGBL) in classrooms has profoundly impacted teaching practices and research, emphasizing the need for professional development and further research. Teachers who incorporate digital games into their instruction require training and support to integrate them into the curriculum effectively. According to a study (Takeuchi & Vaala, 2014), 31% of game-using teachers were unsure how to integrate digital games into the classroom. To address this, 68% sought ongoing professional learning from their colleagues within their school or district, and 80% expressed a desire for easier access to digital games aligned with curriculum standards. The successful incorporation of DGBL in the classroom necessitates professional development that provides educators with technical skills and pedagogical strategies to enhance student engagement and learning outcomes. This includes training in game selection, designing game-based activities, and utilizing game analytics to inform instructional decisions.

As the field of DGBL continues to evolve, numerous areas warrant further investigation. Research can explore the effectiveness of specific game-based interventions, examining their impact on student motivation, engagement, and learning outcomes across different subjects and grade levels. Additionally, studies can investigate the effectiveness of various game design elements, feedback mechanisms, and adaptive features on student learning and skill development. Furthermore,

research can investigate the impact of DGBL on diverse student populations, exploring how games can support learners with different abilities, learning styles, and cultural backgrounds. By conducting rigorous research in these areas, educators and researchers can continuously refine and enhance the use of DGBL in the classroom.

Conclusion

The integration of digital games in education marks a transformative shift in the modern era of learning. The rise of digital game-based learning (DGBL) within the expansive EdTech market showcases its potential as a powerful tool for engaging and educating students. Interconnected with emerging technologies like virtual reality, artificial intelligence, adaptive learning, and more, DGBL offers personalized and immersive learning experiences that improve student motivation, mastery of curricular content, and sustained attention.

While the benefits of DGBL are evident, ethical concerns and access disparities demand attention. Data privacy and security must be safeguarded to protect students' information, and efforts must be made to bridge the digital divide and ensure equitable access to technology for all learners. Teachers will require ongoing professional development to effectively integrate digital games into their classrooms, enhancing instructional practices and maximizing the impact of DGBL.

Looking ahead, continued research in DGBL is essential to refine and optimize its implementation. Investigating the effectiveness of specific game-based interventions, diverse learning populations, and various game design elements will further enhance the impact of DGBL on student learning outcomes. The ever-evolving landscape of DGBL and emerging technologies opens doors to a future of interactive and engaging education, empowering students to thrive in an ever-changing world. By leveraging the collective power of digital games and emerging technologies, a dynamic educational experience is fostered that prepares students for success in the digital age.

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TechTalk: Unleashing the Power of Technology in Speech-Language Pathology

Kelli Snyder

Technology is an integral part of speech-language pathology. Speech-Language Pathologists (SLPs) use technology to complete evaluations, provide intervention services, and support the speech and language needs of their clients. Technological advancements of augmentative and alternative communication (AAC) devices have allowed individuals with significant physical and communication impairments to communicate using the gaze of their eye or the twitch of an eyebrow. By embracing technology, SLPs are equipped with powerful tools that can give voice to their clients, promote personalized treatment, and engage young students. The multifaceted impacts of technology on the field of speech-language pathology have revolutionized intervention approaches, expanded services, and increased the accessibility of AAC. Given how quickly technology is evolving, it is critical to evaluate its advantages and its drawbacks and potential ethical implications when incorporating technology into the work of SLPs.

Augmentative and Alternative Communication

The American Speech-Language-Hearing Association (ASHA) defines augmentative and alternative communication (AAC) as an area of clinical practice for SLPs that falls under the broader category of assistive technology (ASHA, n.d.). AAC utilizes a variety of techniques and tools to supplement or compensate for impairments in speech and language production or comprehension. For individuals with minimal expressive language, AAC provides a medium to express their thoughts, needs, feelings, and ideas. AAC may include low-tech tools such as communication boards with pictures, symbols, or words, to high-tech devices, such as speech-generating devices, communication applications on tablets (e.g., Proloquo2go on an iPad), or eye gaze systems where individuals with limited motor

control communicate using their eye movements and specialized cameras.

AAC has experienced significant technological changes and advancements that have a profound impact on the individuals who utilize them (Light, McNaughton, Beukelman, et al., 2019). Twenty years ago, the voices used in AAC devices were robotic and artificial; however, today, the voices sound natural and can be customized to represent the user's cultural and linguistic background and regional variations. The increased use and availability of mobile technologies have led to greater acceptance of AAC and a decrease in the cost, resulting in greater access to individuals who need it (Light, McNaughton, & Caron, 2019). The development and advancement of alternative access techniques such as eye tracking technologies have given AAC access to individuals with severe motor impairments who could not previously access these devices (Fager et al., 2019). These advancements allow for more effective and efficient access for individuals with physical and motor impairments to clearly communicate.

Artificial intelligence (AI) has had a significant impact on AAC (Sennott et al., 2019). AI can improve predictions and personalization of AAC devices by analyzing vast amounts of data and learning the user's patterns to make more accurate predictions about their communication needs. AI can be utilized to recognize and interpret gestures and offer word or picture predictions, improving communication speed and efficiency for users, which is particularly important for AAC users with physical difficulties (Light, McNaughton, & Caron, 2019).

Utilizing AI, AAC may be designed to identify a person's inherent needs and abilities as well as extrinsic environmental factors and offer individualized adjustments in real time (Light, McNaughton, Beukelman, et al., 2019). AAC devices are already designed to utilize AI to assess the noise level and adjust the device's volume level accordingly. Further utilizing AI could determine the location or activity of the user and suggest appropriate vocabulary for the situation (Fager et al., 2019). AI may pinpoint crucial transitions in language development and advise parents and SLPs on next steps (e.g., suggesting language concepts to add to the vocabulary repertoire

on the device), assisting with the complex and time-consuming decision-making required for updating and programming AAC devices (Light, McNaughton, Beukelman, et al., 2019).

Although the benefits of AAC seem endless, there are limitations of AAC. These advanced technologies and AAC devices may not be available to individuals from lower income communities (Light, McNaughton, Beukelman, et al., 2019), leading to disparities in access and availability to individuals from marginalized communities or regions with limited resources. Incorporating AI into AAC devices will rely on collecting and analyzing personal data from adults and children that may be considered vulnerable due to their ability level (Sennott et al., 2019). Data collected could include communication patterns, locations, personal information, and user preferences, and the ethics and safety regarding the storage, security, and potential misuse of that data must be considered. Valencia et al. (2023) noted AAC users' desire to input confidential information including medical information onto their devices to share in emergencies when the need to communicate quickly is essential; however, users stated significant concerns regarding data breaches, others having access to their personal and medical information, and data being used without their consent. These limitations must be considered and addressed to ensure that all individuals who would benefit from AAC have access to safe, reliable, and modern technology.

Utilizing Technology in Speech Therapy

As technology continues to advance and revolutionize AAC, it has also expanded the array of innovative tools and resources available to SLPs for their day-to-day practice and therapeutic interventions. Technology can be used in interactive ways to support and promote social motivation, group engagement, adult-child interactions, and the relevance of instruction (Sauermilch, 2021). SLPs have embraced technology in their practice by incorporating tablet device applications (e.g., iPad apps) to support intervention practices and increase student engagement (Roper & Skeat, 2022). Responses from a nationwide survey of SLP graduate students indicated that 92% of 683 respondents implement therapeutic activities obtained

from social media or online resources (Boster & McCarthy, 2018). Another survey of school based SLPs found that over 50% reported using iPads or similar tablet technology for speech and language intervention (Albudoor & Peña, 2021). SLPs reported that screen-based devices increased their clinical effectiveness, increased student engagement and participation, and supported students in achieving intervention goals (Sauermilch, 2021). SLPs integrate apps into speech therapy sessions to replace or enhance traditional materials to elicit target speech sounds, language goals, and social behaviors like turn-taking and requesting (Du et al., 2023).

Albudoor and Peña (2021) found over 26,000 available apps that met the search criteria for speech or language therapy; however, the plethora of available apps and online resources may lead to practices that are unsupported by evidence. Furlong et al. (2018) reviewed 4,033 apps that met the search criteria for speech sound treatment and found that only 19 had potential therapeutic benefit as noted by the Mobile Application Scale, a tool used for assessing the quality and therapeutic impact of health-related apps. Boster and McCarthy (2018) found that SLPs report using technological resources that are inexpensive, convenient, and recommended by others, with less thought about their empirical support. Without thorough evaluation and consideration of evidence-based practices when selecting apps for therapeutic services, the large number of available apps and resources pose a risk to evidence-based practices and the quality of the therapeutic activity.

Although there is potential for technological resources such as apps to improve speech and language services, the sheer number and unregulated nature of them risk clinical integrity (Albudoor & Peña, 2021). Guidance for SLPs and SLP graduate students on how to evaluate and navigate the volume of resources is necessary for SLPs to select apps and resources that are based on evidence-based practices. SLPs often select content of high interest to students to increase attention and engagement (Sauermilch, 2021); however, Du et al. (2023) noted the importance of awareness of ethical practices when using apps during speech and language therapy, citing concerns with in-app advertisements and age appropriateness of content.

As the availability and inclusion of technology increases, it is essential to address the concerns associated with increased screen time, particularly when working with children. As SLPs increasingly utilize tablets during speech therapy sessions, there is a need to carefully balance the benefits of technology with the potential risks of excessive screen exposure. Screen-based devices can negatively impact communication development, as an association has been found between excessive screen time and communication related delays (Madigan et al., 2019) as well as poorer language skills in children who spend time on screen-based devices versus children who do not (Madigan et al., 2020). Excessive screen time can impact the quantity and quality of parent and child interactions and communicative play, which plays a critical role in language, social and cognitive development (Sauermilch, 2021). The language-rich environments that SLPs specifically design to treat speech and language impairments in young children risk being hampered by screen-based devices. SLPs must consider this and find balance when incorporating screen-based technology into therapeutic sessions.

Telehealth

While advancements in AAC and tablet technology have greatly impacted the field of speech-language pathology, another significant area of advancement in recent years has been the integration and advancement of telehealth services, revolutionizing how SLPs deliver assessment, intervention, and support to individuals remotely. SLPs have utilized telehealth since the mid-1970's, when a SLP at one hospital or clinical site used a closed circuit linked television system to communicate with an individual or group at another site (Roper & Skeat, 2022). Clients were required to travel to the site, but it allowed SLPs to provide specialized services to individuals in different geographical areas. Telehealth has evolved since its humble beginning and saw an exponential growth of usage and acceptance during and following the COVID-19 pandemic (Campbell & Goldstein, 2022).

Telehealth has proven itself a viable option for providing services to clients of all ages (McLeod et al., 2020). Once

thought to only benefit adults in geographically remote areas, SLPs' response from the COVID-19 pandemic proved that telehealth is a therapeutic option for all ages, ability levels, and geographical locations. Traditional services from a SLP relied on face-to-face interactions in a clinical or educational setting; however, advancements in telehealth have expanded the ability of SLPs to assess, consult, and treat a variety of speech and language disorders (Little et al., 2022). Telehealth improved access to services from SLPs for individuals residing in remote or underserved areas, allowing them to receive SLP services without the need for travel. Telehealth also offers convenience and flexibility for both SLPs and clients and can increase parent or caregiver involvement as they can participate in sessions from their home or work setting (McLeod et al., 2020). Regulatory changes during and following the COVID-19 pandemic allowed for increased access and reimbursement of telehealth (American Speech-Language-Hearing Association, 2023), eliminating regulatory and insurance hurdles that previously impacted its usage (Little et al., 2022).

As the availability of technology increased and its cost to users decreased (Light, McNaughton, & Caron, 2019), telehealth availability increased to individuals from a variety of socioeconomic backgrounds living in varying geographical locations (Campbell & Goldstein, 2022). Users no longer required expensive software or equipment but could receive services from a home computer or tablet. Patient satisfaction was found to be nearly equal to in-person services, particularly as the number of telehealth sessions increased (Little et al., 2022).

A significant challenge of telehealth is its dependence on consistent high-speed internet access (Edwards-Gaither et al., 2023). The availability of appropriate technological devices and technology literacy can also contribute to disparities in access for certain populations. Additionally, SLPs must adhere to privacy regulations to protect client confidentiality and maintain a secure online environment for therapy sessions (American Speech-Language-Hearing Association, 2023). By carefully navigating these considerations, telehealth has the potential to revolutionize the field, bridging geographical barriers and enhancing the reach and impact of SLP services.

Conclusion

Technological advancements have had a profound and positive impact on the field of speech-language pathology. The development and improvement of AAC devices, coupled with the widespread availability of tablets and apps, has revolutionized communication interventions, fostering increased success, participation, and access for individuals with speech and language disorders. Moreover, the integration of telehealth services has expanded the reach of SLPs, enabling assessment, intervention, and support to be delivered remotely, overcoming geographical and global pandemic barriers, and increasing access to services. It is important to acknowledge potential concerns such as increased screen time for children and ethical and privacy issues associated with AAC and app usage. Sustained vigilance, continued trainings, and appropriate use of technology are necessary to mitigate these challenges. Overall, the positive impact of technology in the field of speech-language pathology far outweighs the challenges, empowering both SLPs and individuals requiring their services to embrace new possibilities, enhance communication outcomes, and achieve greater inclusivity. As technology continues to evolve, the future holds immense potential for further advancements, ensuring a brighter and more connected future for the field of speech-language pathology.

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How Artificial Intelligence Impacts Language Learning

Martha G. Haugerud

In recent years, artificial intelligence has gained tremendous notoriety. Rapid advances in artificial intelligence (AI) have revolutionized many industries, including education. AI has emerged as a powerful tool with the potential to change traditional educational practices. With its ability to analyze large amounts of data, learn patterns, and make informed predictions, AI offers new possibilities for education, guiding users to a more personalized learning experience and improving various outcomes.

Artificial intelligence has an impact in learning a second language particularly in translation tools. AI-based language translation tools have made significant progress in breaking down language barriers. These tools utilize deep neural networks and natural language processing techniques to facilitate smooth and accurate translations between different languages. This article will analyze various AI utilized to translate a language and how it impacts the learning experience for users.

Despite the various benefits, educators and users face several challenges when integrating AI into a learning experience. Such challenges also carry ethical concerns that educators must consider promoting responsible and appropriate use of AI.

How Artificial Intelligence impacts language learning

AI Background

According to Perez Orozco (2018), the development of technology is producing a new modality of intelligence that is added to human intelligence: the so-called "artificial intelligence" based on "learning machines." As stated by Rouse (2017), artificial intelligence is understood as the simulation of human intelligence processes by machines (robots), especially computer systems.

In 1955, the concept of artificial intelligence (AI) was introduced by computer scientists McCarty, Minsky, Rochester, and Shannon (1955/2006). Artificial intelligence refers to the computer science and technology that focuses on the development of intelligent machines, which are capable of performing tasks commonly performed by humans. "Computer systems that are capable of human-like processes such as learning, adapting, synthesizing, self-correcting, and using data for complex processing tasks"(p.2) is how Openici and Kerr (2017) described IA. Other researchers contend that the first instance of artificial intelligence, the calculator created by Alan Turing in 1936, marked the beginning of AI.

As the technology continues to develop in different areas such as healthcare, finance, customer service, agriculture, entertainment and education, AI encompasses various fields such as machine learning, natural language processing, computer vision, robotics, and expert systems. In recent years, however, there has been more interest in applying AI to more fields, such as healthcare, industry, and marketing. Currently, AI is already present in any software that replicates human capabilities and is used to perform specific tasks as well as broad and complex tasks (Perez Orozco, 2018). These systems are widespread and their popularity has increased in recent years, for example, AI is present in mobile phones when they have facial recognition and in the use of virtual assistants, the most popular being Apple's Siri, Amazon's Alexa, or Microsoft's Cortana.

The progress of AI has been increasingly influenced by the utilization of big data, which refers to the amount of information generated through the use of devices and the internet. This abundance of data allows AI systems to analyze millions of data points to make predictions regarding user needs, preferences and interests. These insights derived from big data play a crucial role in enhancing AI capabilities and tailoring experiences to individual users.

The impact of AI in education

The emergence of AI in education can have various implications, in a way supporting the emergence of new challenges that require new adjustments to adapt from the

traditional way of teaching to a new technological form to help students learn. These implications can require adjustments to meet new challenges and shifts from traditional teaching methods to technology-enabled approaches that facilitate student learning. AI's impact on education introduces a range of opportunities and considerations; it supports the development of innovative learning environments, individualized instruction, and adaptive learning experiences. Ocañas Fernández et al (2019) mentioned that "AI promises a very substantial improvement in education for all levels by providing the student with personalization of their learning tailored to their requirements, managing to integrate the various forms of human interaction and technology". However, the integration of AI in education requires careful attention to ensure its responsible and effective use.

One of the main goal of Artificial Intelligence in education should be focused on the idea of providing individualized attention to students. Coll (2016) highlights that AI can provide different options to help students receive individualized learning. However, it is important to keep in mind that AI is only a tool to support the learning process, not to do everything for the student.

Artificial Intelligence- based language translation tools

Artificial intelligence has advanced to the point where it is already being used in second language learning, specifically in translation. AI translation tools help learners understand foreign texts and conversations, while speech recognition technologies enable immersive language practice. An example of this is when people use a mobile phone, and users try to send a message, the AI implemented in the device predicts what they want to express and suggests words to complete it. In some cases, AI also corrects misspelled words, enhancing the accuracy of the written communication. In this section, various AI translation tools will be analyzed.

Grammarly

Grammarly is considered an AI tool because it uses artificial intelligence and natural language processing (NLP) techniques to provide automatic grammar checking, spelling correction, and writing suggestions (Grammarly, 2020). Through its AI capabilities, Grammarly aims to improve the writing process and help users produce more polished written content. Grammarly can detect and provide feedback on the correctness, clarity, engagement, and delivery errors in written work (O'Neill & Russell, 2019). It has been used by graduate and undergraduate students to complete writing research papers, dissertations, thesis, and reports from various disciplines (Cavaleri & Dianati, 2016; Gain et al., 2019, pp. 1-13).

According to a study conducted by Im (2021), student's expectations regarding feedback were exceeded by the quality of feedback provided by Grammarly. Additionally, Ghuffron and Rosyida (2018) discovered that Grammarly had a more pronounced corrective impact on student's writing, particularly in terms of dictation, grammar, spelling, and punctuation when compared to traditional didactic feedback approaches. However, it is important to mention that didactic approaches demonstrated stronger corrective effects on content quality and its organization than Grammarly.

Even though Grammarly has several benefits to assist students to improve their writing skills, one powerful drawback is its language limitation, as Grammarly feedback is only offered in English. This poses challenges for users from non - English speaking backgrounds, who may struggle to fully comprehend Grammarly corrective suggestions.

Google Translator

Google Translator uses AI and machine learning techniques to provide translation in different languages. It is known that it uses statistical machine translation and neural machine translation models (Bahdanau, D., Cho, K., & Bengio, Y., 2015) to analyze and understand in one language and then translate to the target language. GT has gained popularity due to several factors. First, people have easy and instant access, users

do not have to pay extra money to use this tool, which happens with Grammarly, and Google is continuously improving the translation quality.

This AI tool also has the advantage of being integrated with other platforms, such as web browsers and mobile applications, making it one of the easiest translation apps to use. In 2022, Google announced that GT will have an upgraded version capable of translation in real time like in storefronts, menus, documents, business cards and other items (Perez, 2022). Google will offer real time translation while also rebuilding the pixels underneath with AI background to make the process of reading the translation feel more natural. In the future Google is planning on investing in creating AR glasses as a tool to translate text in the real world, being a powerful reason to sell this device.

Texts can be translated quickly and easily with Google Translator. It does, however, have some restrictions. Its accuracy is a notable limitation as it occasionally makes mistakes when attempting to translate between different language variants despite knowing many distinct languages.For instance, even though GT claims that the word "chapuza" means "botch," in Spanish, "chapuza" refers to engaging in dishonest behavior to fit in with something, such as a job, game, or grade. Unfortunately, there is no accurate translation of "chapuza" from Spanish to English. Furthermore, cultural quirks and phrases are not considered during the translation process, which might make it difficult to fully comprehend a foreign language.

Microsoft translator

Microsoft Translator is an innovative cloud-based translation service offered by Microsoft. It empowers users to effortlessly translate text, speech, and even images in multiple languages. This versatile service is accessible through different platforms, such as web, mobile apps, and Application Programming Interface (API) (Nimbalkar, S. et al 2020). To deliver highly accurate translations, Microsoft Translator harnesses cutting-edge artificial intelligence and machine learning technologies. By utilizing advanced neural network models and statistical algorithms, it continuously enhances the quality of its translations.

Microsoft Translator (MT) has some restrictions, just as other translation software. It only offers one kind of interpretation and a small number of supported languages. Additionally, when translating from one language to another, MT may experience accuracy issues, particularly when it comes to including particular country or region-specific variants. For instance, Colombian Spanish has a large number of words that cannot be accurately translated due to cultural nuances. For instance, the word "trasnochar" has the meaning "to stay up late" in English, but there is no word that defines it in English. Another illustration would be the word "estrenar," which in English would mean "brand new," but once more, there is no word that describes the process of donning something that is brand new.

DeepL Translator

DeepL Translator is an advanced machine translation tool developed by the German company DeepL GmbH. It utilizes deep learning technology to offer high-quality translations in numerous languages. Renowned for its exceptional accuracy and natural-sounding translations, DeepL Translator has become a popular choice due to its proficiency in handling complex sentences and preserving the intended meaning. It supports a broad spectrum of languages and provides both free and premium subscription options for users.

One of the primary limitations of this AI translation tool is its inability to fully contextualize the message during translation. While it performs well with general text and certain specialized domains, it may encounter difficulties when dealing with highly technical, industry-specific, or domain-specific content. Translations in these areas may necessitate additional human expertise or specialized translation tools to ensure accuracy and precision.

AI Challenges faced by World language Educators

Artificial Intelligence has gained significant popularity among students and young individuals. It has become a valuable tool for assisting with homework completion and enhancing

understanding of various concepts across different subjects. In a recent study by Pew Research Center (2023), participants were asked to express their concerns regarding the digital AI impact anticipated by 2035, particularly concerning the use of AI. The responses obtained from the study were highly alarming. Judith Donath warned: “The accelerating ability to influence our beliefs and behavior is likely to be used to exploit us; to stoke a gnawing dissatisfaction assuaged only with vast doses of retail therapy; to create rifts and divisions and a heightened anxiety calculated to send voters to the perceived safety of domineering authoritarians"(Pew Research Center, 2023). AI is a tool that supports learning experiences, but when language learners use AI, teachers can face various challenges in their classrooms. One notable challenge is the potential over-reliance on AI as a substitute for human interaction.

Language learning not only involves acquiring grammar and vocabulary but also developing communication and cultural understanding. If students predominantly rely on AI language tools for practice, it may hinder their ability to engage in authentic conversations with real people (Forbes, 2023). World language educators must find ways to establish a balance between AI-assisted learning and creating opportunities for meaningful human interaction, such as pair work or group discussions.

There is another challenge involved in making sure that AI-generated content is accurate and appropriate. The language tools used for AI might have limitations when it comes to understanding context, cultural nuances, and generating language that is contextually suitable. Therefore, it's important for teachers to carefully assess and select the AI resources they use in the classroom, ensuring they align with the learning objectives and suit the students' proficiency levels. Moreover, teachers should help students develop critical thinking skills so that they can evaluate the accuracy and relevance of the AI-generated content. This will enable them to distinguish between reliable and unreliable information. By addressing these challenges, teachers can effectively incorporate AI into language learning while still giving priority to authentic communication and the development of critical thinking skills.

In a recent article published by Forbes (2023), educators' concerns about Artificial Intelligence were highlighted. Many teachers feel threatened by AI, as they fear it may automate their tasks and ultimately render them redundant. The intended purpose of AI is not to substitute teachers, but instead to help them with their tasks.

Ethical considerations

When using Artificial Intelligence, users should be aware of ethical implications surrounding its use. First consideration is related to privacy. All AI users need to be careful with privacy, because constantly AI requires access to personal data in order to function effectively. Users must be mindful of how their data is being collected, stored, and used by AI systems (Forbes, 2023). It is important to review privacy policies and terms of service of AI tools and ensure that personal information is handled in a secure and transparent manner. Additionally, users should be cautious when granting permissions and of potential risks associated with sharing sensitive data.

Another ethical consideration is related to inclusivity. Educators should be cautious in selecting or creating AI tools that are sensitive to individual differences and cultural diversity. AI systems should not perpetuate biases or discriminatory practices but instead promote equal opportunities and cultural understanding. Educators should continuously evaluate and monitor the AI tools they use, particularly in the context of second language acquisition, to ensure they do not inadvertently reinforce stereotypes or create exclusionary learning experiences.

Understanding data collection practices and the risks associated with sharing personal information is critical for AI users. In addition, users should actively address bias and advocate for fairness in AI systems to ensure they are inclusive, accountable, and aligned with ethical principles. The ethical use of AI should be promoted in schools, with educators modeling the proper use of Artificial Intelligence.

Conclusion

Artificial Intelligence (AI) has transformed many aspects of people's lives, including education. With its remarkable capabilities, AI has had a significant impact on the field of education, enabling innovative learning experiences and personalized approaches. One area where AI has made a big difference is in language learning, particularly translation. AI translation tools have impacted the way we communicate, attempting to bring accurate translation to texts and conversations and breaking down language barriers.

However, despite the various benefits of using AI in various translation tools, educators and users face several challenges, two of the most important being privacy and the accuracy of using AI to understand a second language. In addition, AI translation tools may have difficulty capturing cultural nuance and context, requiring educators and users to strike a balance between technological solutions and human interaction.

Ethical considerations need to be addressed. Concerns such as privacy and the responsible use of AI in education must be addressed. By embracing AI advances with sensitivity and a thoughtful approach, AI can be a powerful tool to help users enhance their learning experiences.

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Shaping the Future for Inclusive Education with Emerging Technologies

Ixchell L. Tolentino

For several decades, assistive technology has been supporting students with disabilities in accessing education and promoting inclusivity which has evolved over time. For example, Braille typewriters and hearing aids were introduced to assist students with visual and hearing impairments. Developed technologies such as basic software and hardware solutions such as screen readers, speech synthesis, and input devices like keyboards enabled students with physical, sensory, and learning disabilities to engage more effectively in educational settings. Text to speech, reading pens, and audible books are easily accessible for students with dyslexia, processing disorders, and attention deficit hyperactivity disorder (ADHD).

Inclusive education goes beyond addressing the needs of students with learning differences and strives to create responsive learning environments that cater to the diverse needs of all students. With the rapid evolution of emerging technologies like artificial intelligence (AI), machine learning, and the Internet of Things, inclusive education is undergoing a transformative shift. These technologies are reshaping the landscape of inclusive education, offering new opportunities and possibilities.

New Technologies and Inclusive Education

The rapid expansion and influence of artificial intelligence (AI), machine learning (ML), and other emerging technologies in education indicate a transformative impact on inclusive education by reshaping students' experiences both in and outside the traditional classroom setting. This expansion is comparable to the widespread popularity seen in activities like creating and consuming TikTok videos. The prevalence of devices like smartphones and wearables is matched by the accelerating adoption of cutting-edge technologies such as AI and ML. These new technologies have the potential to revolutionize education by altering students' experiences inside

and outside of the classroom, which will influence their physical, social-emotional, and intellectual learning outcomes (Chauhan, S., 2017 and Salas-Pilco, S.Z., 2020). The literature on technologies and inclusive education has highlighted that these emerging technologies have the potential to support student engagement, provide low-risk environments, scaffold learning goals, create authentic environments that include students with disabilities, support collaborative learning, and reinforce positive social behavior (Hite et al., 2021, McMahon et. al., 2019, Roberts-Yates, C. and Silvera-Tawil, D. 2019).

Artificial intelligence (AI) and machine learning (ML) have been contributing to inclusive education by enhancing personalized learning. AI enhances tools and instruments used day by day in schools around the world from internet search engines, smartphone applications, public transportation, and household appliances. Assistive technologies are embedded in all these instruments, too. Machine learning, through the implementation of early warning systems, plays a pivotal role in predicting student performance. For instance, a study utilized machine learning to identify at-risk students from underrepresented populations, while another investigation focused on teaching artificial intelligence and machine learning to African American youth as part of a STEM course (Cano, A., & Leonard, J. D. 2019).

As the landscape of inclusive education expands through technologies like artificial intelligence and machine learning, it is imperative to recognize the parallel evolution of mobile technology, which not only serves as a communication tool but has also become an instrumental force in fostering inclusive learning experiences. Originally a means of communication, mobile technology continually advances its many uses from entertainment to education. Mobile devices are flexible, affordable, accessible, and portable. Students can communicate in different languages with access to translation and learn new languages with downloadable applications. One example of how mobile devices have helped to empower marginalized students is when a print newspaper was produced and created using cell phones in a high school journalism classroom (Cybart-Persenaire, A., & Literat, I. 2018). These are examples of how

mobile technology can significantly support high-quality inclusive education.

Another new technology is serious games which are part of the emerging technology revolution. Serious games are digital games whose purpose is to cultivate students' knowledge and skills by integrating educational elements. These games have proven effective in improving cognitive abilities, motivation, and engagement. Serious games were also used to increase the minority students' positive attitudes toward engineering and STEM (Ball et. al., 2018). Additionally, serious games have proven effective in fostering creativity in game design while reinforcing learning outcomes (Robles- Bykbaev et. al., 2019). By incorporating serious games into the educational experience, educators have found innovative ways to engage students, promote positive attitudes, and facilitate meaningful learning experiences.

Learning Analytics is an emerging field that has garnered significant attention in recent years. While research on learning and teaching, student progress tracking, and data analysis has been conducted for a long time, Learning Analytics takes advantage of new opportunities presented by the capture of digital data from students' learning activities, as well as the application of computational analysis techniques from data science and AI. By employing this technology, it becomes possible to analyze data from learners' activities and derive meaningful insights and visualizations (Gedrimiene et. al., 2019). Numerous studies have demonstrated the potential of Learning Analytics, such as developing tailored interventions to enhance retention, identifying inequality in academic attainment, and exploring student engagement (DeRocchis et. al. 2018, Nguyen et. al., 2019, Williams et. al., 2019).

Virtual Reality (VR) and Augmented Reality (AR) have emerged as innovative technologies that significantly contribute to inclusive education. Notably, studies have demonstrated that VR can serve as a powerful tool for enhancing intercultural sensitivity among students. Through immersive experiences, students can engage with diverse cultural perspectives, fostering a deeper understanding and appreciation for different cultures. Additionally, VR has proven effective as an assessment tool in

higher education, allowing educators to create experiential assessments that go beyond traditional methods. On the other hand, Augmented Reality (AR) has been successfully employed to support student motivation by introducing interactive and engaging elements into the learning environment (Pinto et al., 2017; Jong et al., 2021; Sun et al., 2019). The integration of these technologies and methodologies into educational practices has opened new possibilities for enhancing teaching and learning experiences, fostering inclusivity, and promoting student engagement across diverse domains.

Benefits and Challenges of Technological Advancements

The integration of artificial intelligence (AI) and emerging technologies in inclusive education not only promises to revolutionize traditional learning methods but also offers a myriad of potential benefits, ranging from improved student performance and heightened interest in STEM/STEAM fields to enhanced engagement and the creation of culturally sensitive learning environments tailored to the unique needs of minority students. For instance, through personalized feedback, machine learning and AI algorithms have demonstrated a positive impact on students' self-efficacy (Cano & Leonard, 2019; Sun et al., 2019). In one study, the implementation of a mobile application and 3D modeling specifically targeted minority students, effectively fostering their interest in computing and engineering subjects (Ladeji-Osias et al., 2018). Moreover, learning analytics plays a crucial role in identifying at-risk students, delivering individualized interventions, and promoting cultural awareness, thereby addressing their unique educational requirements (Bayer et al., 2021; DeRocchis et al., 2018; Pinto et al., 2017). By integrating AI, inclusive education can cater to diverse learners, empower students, and provide personalized interventions that meet their educational needs. Continued embracement of these advancements will pave the way for a more inclusive and equitable education system, equipping students with the skills and opportunities they need for a future driven by innovation and growth.

The rapid development and integration of AI and emerging technologies presents a range of challenges that must be overcome to fully harness their potential across diverse

domains. These challenges encompass technological and pedagogical hurdles, dataset limitations, and cultural differences. For instance, access to technology and the high costs associated with advanced technology pose barriers to widespread adoption (Ball et al., 2018). To bridge the digital divide and promote equitable access, educational institutions serving disadvantaged students need to enhance their technological resources (Walters, A. 2020). Pedagogical challenges, such as time constraints for creative activities, limitations in group work facilitated by certain technologies, and the need for learner pre-training, can hinder the effective integration of AI and new technologies (Jong et al., 2021; Robles-Bykbaev et al., 2018).

Another significant challenge lies in the availability and quality of datasets, which impact the accurate evaluation of students' performance. The lack of precise evaluation datasets and the need for detailed data on students from diverse ethnic backgrounds' interaction with technology have been highlighted in studies (DeRocchis et al., 2018; Pinto et al., 2017). These studies have emphasized the importance of having accurate assessment datasets and comprehensive information regarding the interactions of students from diverse ethnic backgrounds with technology given potential biases or inaccuracies when evaluating performance. Moreover, cultural differences present complex challenges that demand careful consideration in inclusive education. Inclusive educational technologies must address cultural bias and promote cultural inclusion to overcome hidden barriers, enabling the achievement of truly inclusive societies (Kazimzade et al., 2017).

By actively addressing these challenges and striving for inclusive and equitable implementation, we can unlock the full potential of AI and emerging technologies to drive positive and transformative change across various domains. This necessitates concerted efforts to bridge the digital divide, address pedagogical limitations, enhance the availability and quality of datasets, and promote cultural inclusivity. By doing so, we pave the way for an inclusive future where AI and emerging technologies empower individuals and foster equitable opportunities for all.

Implications for the Future

The synthesis of current research reveals a multifaceted approach encompassing pedagogical, technological, and sociocultural strategies to surmount the challenges associated with leveraging artificial intelligence and emerging technologies for the advancement of inclusive education. At the pedagogical level, the solutions are addressing students' needs and preferences; inspiring and motivating teachers; creating flexible and culturally aware courses; and adopting gamified evaluations and learning analytics (Ball et. al., 2018, Jong et. al., 2021, Harteveld et. al., 2020). These solutions show how crucial it is for inclusive education to consider each student's unique requirements, past experiences, and cultural heritage. When integrating inclusive educational technologies, learners' cultural backgrounds are advised. Additionally, developing inclusive education depends on the skills of the teachers and the structure of the curriculum.

Technical solutions are contextualizing technology to consider the characteristics and background of diverse learning needs of students, and providing sufficient resources, such as software that can function on outdated machines and information that considers various sociocultural contexts (Pinto et. al., 2017, Robles-Bykbaev et. al. 2018). AI and new technologies must be contextualized and adjusted to support diversity and inclusion. Technical assistance and relevant digital materials are essential components in utilizing technology for inclusive education successfully.

Sociocultural solutions, as represented by the theme of cultural values, propose that addressing the difficulties faced by minority students can be accomplished by presenting content pertaining to minorities, offering multilingual alternatives, and enhancing the classroom with culturally relevant and authentic learning (Jen-Yi et. al., 2020, Nguyen et. al., 2019, Salas-Pilco, S. Z. 2020). As crucial components of inclusive education, the incorporation of cultural content and appreciation of the values and traditions of minority communities are emphasized.

These recommendations from the reviewed articles emphasize the importance of sociocultural approaches that consider diverse student viewpoints and beliefs, technological advancements that promote diversity and provide adequate

resources, and teaching strategies that consider each student's individual needs. By putting these principles into action, inclusive education may be successfully supported, ensuring that students from all backgrounds are empowered and given equal opportunities for learning and development.

Conclusion

Understanding emerging technologies' revolutionary potential, advantages, drawbacks, and potential future ramifications for improving overall learning outcomes is essential to investigating their influence on inclusive education. The recommendations from the reviewed articles emphasize the importance of sociocultural approaches that consider diverse student viewpoints and beliefs, technological advancements that promote diversity and provide adequate resources, and teaching strategies that consider each student's individual needs. By putting these recommendations into action, inclusive education may be successfully supported, ensuring that students from all backgrounds are empowered and given equal opportunities for learning and development.

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Culturally and Linguistically Responsive Pedagogy: Technology Implications

Megan L.M. Hansen

Culturally responsive pedagogy has interested the education field for well over 40 years. Educators and researchers such as Ramírez and Castañeda (1974), Ladson-Billings (1994), Delpit (1995), Gay (2000), Villegas and Lucas (2007), Hollie (2012), and Hammond (2015), to name a few, have built a foundation for culturally responsive pedagogy (CRP). The landscape of CRP has been evolving, with Ladson-Billings (2014) and Hollie (2019) calling for a "remix" or a rebranding of culturally responsive pedagogy. Hollie's (2017) culturally and linguistically responsive teaching (CLRT) brand is a pedagogy that affirms and validates each student's diverse culture, language, and lived experiences and makes connections to student learning. CLRT provides a welcoming environment representing all students and provides opportunities for building meaningful relationships and communities. Hollie (2019) explains that it is not enough for an institution or district to claim implementation of culturally responsive pedagogy; they must have a theoretical framework that produces change.

The 21st century has been named by many as the age of information. The rapid acquisition of new technologies and access to information marks the era. While the goal for increased access to information through technology provides many benefits to the culturally and linguistically responsive classroom, it also brings some barriers. This article will investigate the potential benefits and barriers technology brings.

Changing Technology

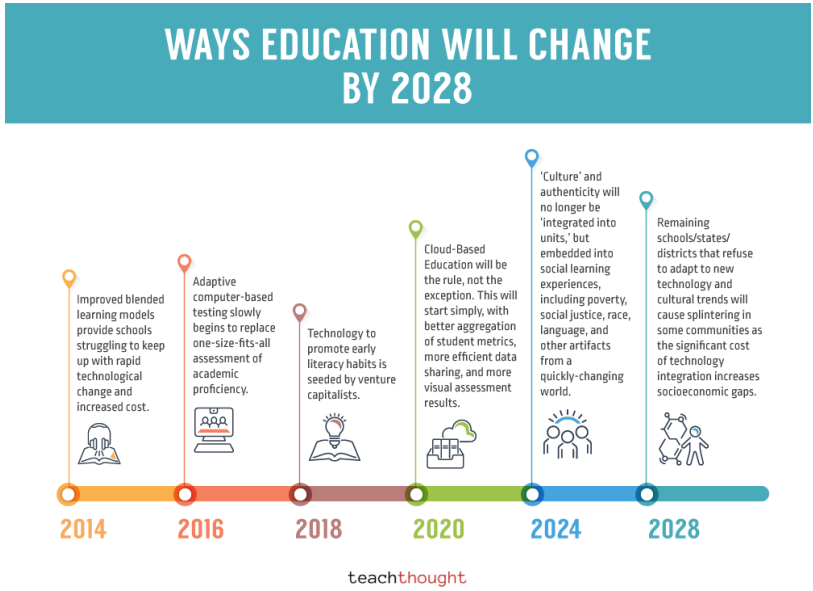
Heick (2013) anticipated the changing landscape of technology and its potential influences on education. Heick noted in Figure 1 several predicted changes, such as 2020 cloud-based education being the rule. Heick was not far off. Companies such as Illuminate Education and their digital program eduCLIMBER are working with districts to create a warehouse of student data that provides one place to find aggregated data,

historical data, and the ability to triangulate data for intervention purposes. Cloud-based education platforms allow employees to share data amongst teams, schools, and the district, monitor interventions, and support multi-tiered systems of support (MTSS) models (Illuminate Education, 2023).

Heick (2013) notes that by 2028 (Figure 1), educational systems that refuse to adapt to changing technologies and cultural trends will lead to continued socioeconomic gaps. The global pandemic began to shed light on the socioeconomic gaps and disparities caused by technologies (United Nations, 2021) and cultural trends. The disparities ranged from lack of internet access and devices to the know-how and experience required to operate devices and programs.

Figure 1

How will technology change education?



Note: This is a prediction of how technology will change education. The figure was created in 2013.

Implications of Data Platforms

How do applications or programs such as eduCLIMBER help support culturally responsive schools or districts? CRT's purpose is to meet the needs of historically underserved populations (Gay, 2000; Hollie, 2017; Ladson-Billings, 2014). Interactive systems such as eduCLIMBER integrate data related to the whole child into one platform. The platform provides educators and school personnel tools to track interventions, collaboration, early warning, and efficient reporting. These tools then improve instruction and interventions to serve the students (Illuminate Education, 2023).

The National Center for Systemic Improvement (NCSI) (2019) suggests that educators must be data literate. It is not enough to look at the data and take a reactive stance. Instead, a proactive approach is imperative. NCSI (2019) rationalizes that culturally responsive educators understand that each student has a cultural identity. Using assessments, attendance, behavioral data, and grades to make judgments and inform decisions is insufficient. Culturally responsive teachers, instead, consider all data points, from classroom assessments and school climate to historical data. Analyzing their diverse students as learners, teachers derive instructional steps from knowledge and understanding of the standards, content, and curriculum. This proactive approach sets high academic expectations for students.

While platforms such as eduCLIMER are a good use of technology to support culturally responsive education, they can also cause barriers. Mandinach (2021) explains the importance of educators understanding Culturally Responsive Data Literacy (CRDL). CRDL is the ability to interpret data and turn it into actionable steps. CRLD is different from data literacy because it strongly focuses on students' individual lived experiences, such as student context, background, and interests, with aggregated educational data (learning analytics). CRDL analyzes any information that may affect a student's behavior or performance in school (Mandinach, 2021). Educators must seek a broad range of data that allows them to analyze students as learners, individuals with lived experiences, unique identities, and personal histories (NCSI, 2019). CRDL provides educators with a format that confronts and challenges implicit biases that may

impact decisions (Mandinach, 2021). When educators process data through a CRDL lens, they shift their thinking. Educators believe that all students can learn and acknowledge the relevance of diversity in schools and how it impacts instruction. Culturally responsive educators identify biases and challenge assumptions, which helps them to identify diverse data and collaborate to find the most effective and actionable solutions (NCSI, 2019).

What happens when educators do not have a culturally responsive mindset? What happens when educators do not have a data analysis orientation or protocol? Students suffer. Ladson-Billings began her CRT journey because she wanted educators to stop looking at what was wrong with Black students and change the narrative to what was right (1995). Over the years, CRT has been transformed by theorists like Hollie (2017), who focus on culture instead of race. Imagine a third-grade student from northeastern Africa transferring from the Newcomers Center to their home school in December. By the middle of January, the teacher is pushing for a special education evaluation. The student struggles in all areas, and classroom assessments support the need for intervention. What is missing from the data conversation is that this student has been in the United States for less than a year. This student is a multilanguage learner and likely needs more time to learn the language. The educators in this example are reactionary and have a deficit mindset concerning the student's learning ability. With this data approach, the student would receive the wrong support by making decisions using only learning analytics. When data is used at face value by educators who are not culturally responsive, deficit thinking becomes probable, responses become reactive versus proactive, and the student's cultural identity may be ignored.

Technology Experience and Access

Cheng et al. (2022) completed a study investigating the impact of teacher experience in technology and their use of it in culturally responsive classrooms. Research proves technology increases student learning when students become more engaged and teachers provide quality content, differentiated instruction, and an ability to practice (Gaminian et al., 2020). Cheng et al.

(2021) determined that teachers' experience and access to technology significantly affected the engagement and achievement of culturally responsive classrooms. Teachers who have had positive experiences with technology are more likely to utilize the technology in engaging ways within the classroom. On the other hand, teachers lacking experience may not use technology to its full capabilities. Take, for instance, interactive whiteboards. Having an interactive board does not make a classroom culturally responsive. If a teacher only uses the board to project a lesson, it is no better than an old overhead projector. According to the National Center for Education Statistics, access to technology has played a role in improved performance. The study showed that students with access to technology outside of school performed between 12 and 21 points better on the 2017 NAEP mathematics assessment, regardless of their socioeconomic status (n.d.). What would happen if schools prioritized access and effective technology use?

Digital Promise (2022), a global nonprofit dedicated to enhancing opportunities for every learner, believes that digital learning and technology support today's widely diverse classroom populations. Digital Promise also argues that technology can worsen marginalized and diverse students' inequities due to a lack of access and opportunities (2022). The culturally responsive teacher can use technology to help overcome inequities. Hollie (2017) expresses the importance of the classroom environment. Culturally responsive classrooms should reflect the students and be rich with language and symbols that build language development. Classrooms should be arranged to support movement, collaboration, and activities that engage students. Culturally responsive educators can create dynamic and interactive lessons. Digital Promise (2022) suggests that through technology, educators can provide students with opportunities for collaboration within the classroom, district, state, country, and even internationally. Students can engage in learning that incorporates their interests and background knowledge. Educators can use technology to affirm students' cultural and linguistic identities (Digital Promise, 2022). Instead of an educator using an interactive whiteboard as a projector, they use it to display an interactive Padlet question. Students

answer the Padlet question independently, work in small groups to organize ideas and discuss their group's thought process. Students then come to the board to move the answers into like ideas. Within the activity, students can process independently, collaborate, move, and manipulate their thinking, which will meet the needs of many diverse learners.

There is another potential barrier to accessibility. It is not just about students having access to the technology. Yerdelen-Damar et al. (2017) found that teachers with personal experience with technologies tended to believe in the positive implications of technology use in classrooms. The teachers' positive attitudes and competencies statistically impacted the use of technologies in the classroom. Teachers who frequently used technology in their personal lives were likelier to integrate interactive technology into their classrooms. Surprisingly, Yerdelen-Damar et al. (2017) did not find a correlation between classroom technology access and teacher use. Just because classrooms have technology does not mean teachers will use it to support culturally responsive learning.

In order to avoid the barriers of unused and untapped technologies that support diverse learners and build on CLR classrooms, institutions, and districts must support their educators in developing their competencies and agency around technology (Yerdelen-Damar et al., 2017). When educators refuse to use new technologies or accept new cultural trends, they add to the disparities of underserved communities (Heick, 2013). It is up to educators to help bridge the gap, not to add to it.

How to Choose

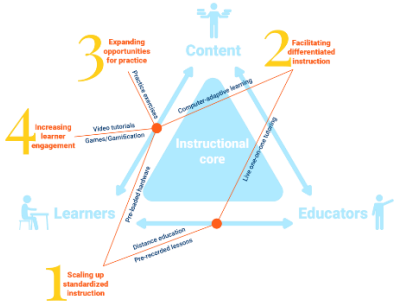
Hollie (2019) noted the importance of knowing students, their cultural identities, and their learning styles and using that knowledge intentionally when instructing. Culturally responsive instruction should transcend traditional curricula and instruction. One way to do so would be by using responsive technologies, including but not limited to devices, applications, and software. Gaminian et al. (2020) suggest ways educators and institutions can identify meaningful technologies. The authors note that not all technologies work for every classroom due to differences in

access, ability, and confidence. Educators or decision-makers must analyze each technology to ensure it is the right fit. With new technologies and information becoming available daily, it would be impossible to use every new tool.

Gaminian et al. (2020) share a structure where educators make decisions around technology, analyzing the potential the technology has to complement core instruction and accelerate student learning (Figure 2). The four comparative advantages that should be considered when picking new technologies are: 1. Does it improve the instruction? 2. Does it allow for differentiated instruction? 3. Does it provide practice opportunities? 4. Does it increase student engagement? (Gaminian et al., 2020). These four comparative advantages overlap the needs of a culturally responsive classroom. CLR starts with core instruction and carefully chooses practices or protocols to enhance learning and set high expectations for the diverse community. With the use of CLR protocols, educators can differentiate the lesson. CLRT vocabulary protocols require practice opportunities to support vocabulary acquisition better. Finally, the driving force of CLR and CLRT is to increase the learner's engagement (Hollie, 2017). When students are engaged and interested, their agency for learning the content becomes untouchable.

Figure 2

Comparative Advantages of Technology



Note: The figure is Caminian et al.'s adaptation from Cohen and Ball (1999)

Conclusion

It is scary how accurate Heick's (2013) predictions (Figure 1) of the future of technology have been. Technology is the super highway, where keeping up with all the changes is impossible. New technologies and access to information gathering provide new opportunities for students and educators while potentially creating barriers for some. Data platforms provide educators the tools to make informed decisions, but unchecked biases and flawed data can give the wrong picture. New technology tools are not always an option; when they are, they are not always practical. Access, competence, and experience play a significant role in the impact of technology on student learning. Adding the added focus of being culturally responsive makes it more complex. Educators must make informed and analyzed decisions about the technology they plan to use. They should consider whether technology helps create a high-achieving, highly engaging, culturally validating environment for diverse learners. When educators use technology to enhance the learning of diverse students, everyone benefits.

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ChatGPT and its Potential Role as Assistive Technology with Students with Emotional Behavioral Disorders

Nick Pocius

Assistive technology has been essential to special education for almost 30 years. Since the Assistive Technology Act of 1998 (Lee & Templeton, 2008), it is hoped that technology will aid in the access to education for students with disabilities. According to the Assistive Technology Act, amendments to assistive technology can be defined as: "any item, piece of equipment, or product system that is used to increase, maintain, or improve the functional capabilities of a child with a disability."

For students with emotional behavioral disorders, the use of technology may look different than with other students with disabilities. Students with emotional behavioral disorders often present different issues regarding education and everyday life. Pereria and LaVoie (2018) state that students with emotional behavioral disorders often struggle more than their peers and are likelier to drop out of school. These struggles may be emotional dysregulation, mental illness, attention struggles, not complying with rules, relationship with authority, lack of executive functioning skills, or struggles with social interactions. While these struggles may overlap with other forms of disabilities, they are often unique for students with emotional behavioral disorders. When looking at assistive technology to aid these students in school and everyday life, it will likely look much different.

Murray (2018) proposes using assistive technology to enhance social skills for students with emotional behavioral disorders. Murray (2018) states that social skills instruction can be enhanced with technology by using videos to show proper and improper reactions to situations. This is one-way technology can help students with emotional behavioral disorders, but it differs from how assistive technology is used for students with other disabilities. For example, for a student with a learning disability, Harper et al. (2017) found that using the Live Script pen aided not only in the accessibility of the content but also increased the student's overall ownership and enjoyment of learning. This Live

Script pen was a tool that increased, maintained, and improved the functions of the student with the disability. While teaching social skills through technology, as Murray (2018) described, is essential for students with emotional behavioral disorders, it can be argued that this may not truly assist the students with their disability but rather teach them to close a potential deficit gap. The Live Script pen could be used in many circumstances for the individual beyond their education. However, a student with an emotional behavioral disorder will likely not access a catalog of social interactions when they face a situation to see how to behave or respond correctly. The observable difference between the two assistive technologies is that one can be utilized beyond the educational realm to aid in life (Live Script pen). At the same time, the other is used as a teaching modality that may not assist the student in day-to-day life.

In investigating different ways assistive technology can be used for students with emotional behavioral disorders, there is a small amount of research to be found. In 2015, Butler and Monda-Amaya discussed the use of digital media writing as a means to engage students with emotional behavioral disorders. While this is an important endeavor to engage students with emotional behavioral disorders, it sometimes falls into the definition of the purpose of assistive technology as it may not assist, maintain, or improve the individual's functional capabilities.

Parette, Jr. et al. (2007) provided what may be the most comprehensive article on the use of assistive technology for students with emotional behavioral disorders. In their article, the authors highlight how there are many different types of assistive technology for students with disabilities regarding reading, writing, and mathematics, but not necessarily directly aimed at helping with self-regulation or behavior change. Parette, Jr. et al. (2007) outlines some ways to use different types of tools to help develop these skills in students with emotional behavioral

disorders: however, the majority of the suggestions were teacher-driven in that they did not necessarily assist the student but provided the teacher with ways of engaging the student. Some of the ideas the authors present are using stopwatches to

aid in time on task, social stories to aid in instructing social interaction, and speech-to-text to reduce frustration when writing. Likely the only one of these suggestions that may fit into the definition of assistive technology is the speech-to-text tool, as it does assist in the overall functioning of the individual.

With the current rate of technological advancements there needs to be a true form of assistive technology for students with emotional behavioral disorders. Not just tools to aid in the instruction of students but tools that will help these students and individuals in their overall quality of life (the overall functioning of the individual). So why haven't there been more discussions or investigations into tools to aid in the overall functioning of individuals with emotional behavioral disorders? Are there tools that could aid in day-to-day functioning? It is felt that a new tool called Chat GPT could help students with emotional behavioral disorders in their education and daily life by simplifying and increasing their ease of access to knowledge and problem-solving. This article aims to demonstrate ChatGPT as a potential form of assistive technology for students with emotional behavioral disorders.

What is ChatGPT?

ChatGPT is a relatively newer technology that has made waves in the world of education. According to Zhai (2022), ChatGPT is a general-purpose conversation chatbot created by Open AI, introduced on November 30, 2022. The idea of having an Open AI means that one can utilize ChatGPT to have conversations, find information, or anything. Students could use ChatGPT to help them write a sentence, answer a question, or in some cases, even write an essay. Regarding essay writing, Stokel-Walker (2022) states that ChatGPT is a game-changer in the world of education with the potential to end certain types of assessment and writing assignments. Chat GPT is a big deal and has a lot of power and potential for students with emotional behavioral disorders and all students within the education system.

There is much debate on the validity of ChatGPT in education. Tilli et al. (2023) conducted a case study that stated, "The results revealed that ChatGPT has the potential to revolutionize education in different ways." Zhai (2022)

provided many ways that ChatGPT could help enhance education. However, in knowing this, both Zhai (2022) and Tilli et al. (2023) cite some ethical concerns related to using ChatGPT within education.

Tilli et al. (2023) described how the New York City public schools banned ChatGPT because it potentially allowed students to cheat and not complete work that they did not want to complete. While this may be true, Tilli et al. (2023) also pointed out that the manuscripts created were original for the student and could not be replicated. Zhai (2022) provided an extensive list of ethical concerns related to bias, privacy, replacement of human jobs, and lack of transparency. However, within those concerns, Zhai (2022) posed solutions that may help reduce an individual's perception and use of ChatGPT. Baidoo-Anu & Owusu Ansah (2023) also provide some concerns with ChatGPT that it can limit human interaction, which could limit lessons learned through human interaction.

Even though ChatGPT is in its infancy, several articles also have demonstrated this tool's benefits. Zhai (2022) points out that ChatGPT can be used for adaptive learning, individualized learning, personal recommendations, and even identifying early learning concerns. Baidoo-Anu & Owusu Ansah (2023) also provided many additional benefits in that, along with the benefits Zhai (2022) proposed, ChatGPT could also aid in personalized tutoring, language translation, and interactive learning.

ChatGPT is an exciting new tool that presents many options for students. For students with emotional behavioral disorders, it also presents many fantastic options that can indeed be a form of assistive technology as written within the definition Assistive Technology Act of 1998. The following section will discuss this further.

ChatGPT and Students with Emotional Behavioral Disorders

According to Parette Jr. et al. (2007), students with emotional behavioral disorders tend to put much effort and attention into their academics. This effort and attention used towards their academics cause these students to cope in various

ways, which may contribute to them acting out or behaving in a manner that is not desirable within the school environment. Chen (2006) provides a foundational rationale for students with emotional behavioral disorders to receive special skills instruction to aid their functioning in both the academic and social worlds. Leggio and Terras (2019) describe the importance of the teacher needing to develop relationships with students with emotional behavioral disorders and creating an environment where these students can believe in themselves to succeed.

Knowing these characteristics of students with emotional behavioral disorders can ChatGPT fit in as a form of assistive technology? Based on the information presented within this short article, ChatGPT could aid in the functional capabilities of students with emotional behavioral disorders.

First, Parette Jr. et al. (2007) outline how tools are needed for students with emotional behavioral disorders to aid self-regulation and reduce overload. Their article references tools that were likely more common before technological advancements. For example, they describe using palm-based devices to record or aid in self-monitoring. Palm-based devices are now considered phones that can access a tool like ChapGPT.

Based on the description of ChatGPT, this tool may provide support and functionality for students with emotional behavioral disorders. Zhai (2022) and Baidoo-Anu & Owusu Ansah (2023) outline many of the positive aspects of ChatGPT. They state that ChatGPT can aid in adaptive/interactive learning, personalized tutoring, individualized instruction, and personalized recommendations. Applying these positive aspects to the identified needs of students with emotional behavioral disorders is a great fit. If we are looking to reduce overload and stress management (Parette, Jr. et al. 2007) for students with emotional behavioral disorders, ChatGPT can reduce this due to the interactive and personalized learning aspect of the technology. This stress and overload can be reduced by using the tool to ask academic questions on items that cause undue stress. Sometimes students with emotional behavioral disorders quit early and get upset when given a difficult task. Thi disrupts

their learning and the educational process for the student and potentially others. A tool like ChatGPT can aid in reducing this emotional overload (Parette, Jr., et. al 2007) by reducing some of the stress-causing situations that often occur in school.

It has also been identified that students with emotional behavioral disorders struggle with social interaction (Chen, 2006). ChatGPT can also potentially assist in these areas as well with the use of the personalized recommendations of the tool. For example, when a student has a social question they can ask this tool. ChatGPT will provide a recommendation on an appropriate choice to make in that social situation based on previous questions asked. This may not be a perfect solution as some could say it replaces human interaction. However, if the tool is taught to aid these students in their human interactions it may be a viable and functional tool for individuals with emotional behavioral disorders to use beyond their academic lives.

Leggio, et. al (2019) described how valuable the relationship of the teacher is when working with students with emotional behavioral disorders. Nothing can replace the physical teacher, especially within these very important and dynamic relationships. However, ChatGPT may be a tool to aid in facilitating the student-teacher relationship. Mchangla (2023) describes the potential collaborative aspects of ChatGPT. Mchangla (2023) states “It is possible to use ChatGPT to improve the evaluation capabilities of instructors, stimulate collaboration and teamwork among students, and give students more possibilities to learn via trial and experience.” So knowing this, teachers can foster relationships within the educational arena with the use of ChatGPT. For example, a teacher and student could work together with the use of ChatGPT to solve academic, social, or emotional problems. The teacher could guide the student to help them determine if the feedback ChatGPT gave to them was valid and applicable to the problem the student was attempting to solve. This would not only aid the relationship between teacher and student but also help utilize this tool as a true form of assistive technology that could potentially help with the student's ability to function in everyday life.

Based on these connections made from past and present research it is reasonable to believe that there could be a positive correlation between the use of ChatGPT and students with emotional behavioral disorders. However, for these connections to be confirmed further research is needed. The following section will investigate options for future research to aid in identifying the validity of ChatGPT as assistive technology for students with emotional behavioral disorders.

Future Considerations for Research

Since ChatGPT was created less than twelve months ago there is still many unknowns about the tool. There is a lot of reason for excitement and as one can see there seems to be a lot of potential for the use of ChatGPT for students with emotional behavioral disorders as a form of assistive technology. Biswas (2023) reiterates the potential ChatGPT can have in education by stating it can enhance learning and student engagement. There are some potential drawbacks when it comes to ethical concerns as mentioned by Zhai (2022), Tilli, et. al (2023), and Baidoo-Anu & Owusu Ansah (2023). So knowing these potential ethical concerns and many other unidentified unknowns about the use of ChatGPT it is recommended that further exploration and research be completed to truly understand the impact a tool like this can have on students with emotional behavioral disorders.

When focusing on students with emotional behavioral disorders it is felt that the first step in research for ChatGPT would be using the tool in the educational setting to see if it aids in emotional regulation. Since oftentimes this dysregulation gets in the way of learning (Parette, Jr. et. al, 2007), the research could be conducted on the emotional response a student has when given a difficult task with the use of ChatGPT. Parameters could be set on when and how the student utilizes the tool such as to seek answers as opposed to an Internet search or mathematical equation. The response could then be compared to a baseline or previous response of the student when faced with a similar stress-inducing task. The results could then aid in determining if ChatGPT is a viable form of assistive technology when used in this manner.

Additional studies around the use of ChatGPT could be related to its ability to aid in social instruction, interaction, and collaboration with their teacher. For social instruction, ChatGPT could be used to help solve social situations for students both within the educational environment and outside of it. The student could ask the technology for advice or a way to solve a social problem they are facing. Then the student could determine (with the help of the teacher) if this advice is valid and then go put it into action. Then while ChatGPT is being used behavioral incidents could be tracked within the school, the life satisfaction of the student, and feedback from teachers and caregivers in regards to the individual's behavior and social interactions. This in many ways could also identify the power of ChatGPT as a form of assistive technology for students with emotional behavioral disorders.

The collaborative aspect of ChatGPT and its ability to harness the relationship between teacher and student could be assessed when conducting both studies. Lo (2023) states one of the most important ways to mitigate the negative impact of ChatGPT on education is to train the teacher and student on how to properly use it. Since training will likely be needed for both teacher and student it could be required that the teacher and student take the training together to aid in building the relationship and understanding the tool. Then when using the tool to help the student both academically and socially, the collaboration of using ChatGPT can be identified as valid or invalid in helping build the relationship between teacher and student.

Within these recommendations, many more details would need to be identified in order before research is conducted. Given how new ChatGPT is and the many unknowns involved with it, it is felt that these baseline ideas are a practical starting point to aid in identifying if this tool can be truly assistive to students with emotional behavioral disorders. Given there seem to be few tools that act as true assistive technology for students with emotional behavioral disorders, it is felt that ChatGPT has promise and it is hoped that it is studied further.

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How Technology is Shaping the Future of Assistive Technologies for Students with Disabilities in Higher Education

Erin Carter

Background of Assistive Technology for Students with Disabilities in Higher Education

The Americans with Disabilities Act of 1990, as amended, defines the term "disability" as "with respect to an individual, (a) physical or mental impairment that substantially limits one or more major life activities of such individual; (b) the record of such an impairment; or (c) being regarded as having such an impairment" (Betts et al., 2013, p.15). There are three domains of disabilities: communicative, mental, or physical (Betts et al., 2013). People who have disabilities in the communicative domain have visual, hearing, or speech limitations. Those who have disability in the mental domain have a learning disability, an intellectual disability, developmental disability or Alzheimer's disease, senility, or dementia. Lastly, individuals with physical domain disabilities use a wheelchair, cane, crutches, or walker; have difficulty walking a quarter of a mile, climbing a flight of stairs, lifting a 10-pound object, grasping objects, or getting in or out of bed; or a medical condition that contributes to a reported activity limitation (Betts et al., 2013).

Two pieces of legislation were passed that ensures that students with disabilities are adequately supported at colleges and universities (Gin et al, 2021). Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) require that any college or university that receives federal funding must make course modifications to accommodate students with disabilities, as long as such modifications do not change the nature of the program being offered (Section 504 of the Rehabilitation Act, 1973; Americans with Disabilities Act of 1990; ADA Amendments act of 2008; in Gin et al., 2021,). Reasonable accommodations may include modifications to rules, policies, or practices; the removal of architectural, communication, or transportation barriers;

provision of auxiliary aids or the provision of alternative yet equally effective programs, services, or activities (Minnesota State, 2013). However, an institution does not have to make adjustments that would fundamentally alter the nature of a service, program, or activity, or that would result in undue financial or administrative burden on the instructor or institution (U.S. Department of Education, 2020).

In accordance with the Americans with Disabilities Act, a higher education institution may not limit what it spends for auxiliary aids or services or refuse to provide auxiliary aids because it believes that other providers of these services exist or condition its provision of auxiliary aids on availability of funds. In many cases, an institution may meet its obligation to provide auxiliary aids by assisting the student in obtaining the aid or obtaining reimbursement for the cost of an aid from an outside agency or organization, such as a state rehabilitation agency or a private charitable organization (U.S. Department of Education, 2021). The institution remains responsible for providing the aid, whether it is a physical item or specialized personnel such as an interpreter (U.S. Department of Education, 2021). An institution has flexibility in choosing the specific aid or service it provides to the student, as long as the aid or service selected is effective (U.S. Department of Education, 2021).

The online environment can make it more difficult for students to receive accommodations, as they may not be physically on campus to advocate for themselves (Gin et al., 2021). Instructors should be informed that a student's accommodations should apply to any learning environment a student encounters during a course, regardless of whether the course is offered in-person or online (Gin et al., 2021). If an instructor is unwilling to provide an accommodation, then it puts the student in a tenuous position where they are forced to self-advocate in ways that may jeopardize their relationship with the instructor and simultaneously any subjective grading in the course (Gin et al., 2022). A study of students with disabilities revealed that they felt had less overall support and accommodations for their disability in online courses compared with their in-person courses (Terras et al., 2020).

According to the World Wide Web Consortium's Web Accessibility Initiative (WAI), accessibility means that people with disabilities, reduced skills, or situational-induced impairments should be able to access, navigate, interact, and contribute to information available on computers, electronic equipment, and the Internet (Paiva et al., 2021). By following standards outlined by this initiative's Web Accessibility Guidelines version 2.1 (WACG 2.1) published in 2018, software developers will be able to make content more accessible to a broader range of people with disabilities, including blindness and low vision, deafness and hearing loss, limited movement, speech disabilities, photosensitivity, and guidelines for cognitive limitations and learning disabilities (Paiva et al., 2021). Accessibility is the usability of a product, service, environment, or facility by people with the widest range of capabilities (Sanchez-Gordon et al., 2018). The positive effects of accessibility on nondisabled users have been studied, and findings revealed that Web Content Accessibility Guidelines support users with and without disabilities alike. A wide range of users can positively benefit from accessible software (Sanchez-Gordon et al., 2018). Designing accessible online courses is easier and less expensive than developing accommodation strategies once a student with a disability enrolls (Baldwin & Ching, 2021). The Americans with Disabilities Act and Section 504 apply not only to the services, programs, and activities that postsecondary institutions offer to students, but also to those they offer to the public (Clarke & Lhamon, 2023). When colleges, universities, and other postsecondary institutions offer their online programming to the general public, all members of the general public are qualified to access and benefit from those online programs and services (Clarke & Lhamon, 2023).

Approximately twenty percent of the general population self-identify as having a disability (Betts et al., 2013). However, colleges and universities often point out that student reporting rates are lower than national reporting rates with only eleven percent of postsecondary students self-identifying as having a disability (Betts et al., 2013). Not all students with disabilities inform their college of their disability, which is the first step in potentially receiving accommodations and services. In 2016,

among college students who had a disability, thirteen percent of students informed their four-year college of their disability, while twenty four percent did not inform their college; twelve percent of students informed their two-year college of their disability, while seventeen percent did not (United States Department of Education, 2022). For that same cohort of students, eighty five percent of students in four-year colleges received accommodations or services after informing their college of their disability, compared to fifty seven percent of students in two-year colleges received accommodations or services after informing their college (United States Department of Education, 2022). Students with disabilities do not always feel comfortable talking with their peers or professors about their disability (Hanley et al., 2011). Even when students perceive their disabilities negatively impact their academic performance, they may not know what accommodations to request, or the technology available in online courses (such as text enlargement or screen-readers) which negates the need to request accommodations (Terras et al., 2015).

Current State of Accommodations and Assistive Technology in Higher Education

Most information technology products and resources used in higher education were not created with accessibility in mind, and do not conform to accessibility standards (Wilson, 2016). Consequently, students with disabilities are excluded from participating fully in their education (Hanley et al., 2011). According to the National Center for College Students with Disabilities, the top five most commonly provided accommodations are test accommodations, alternate formats of course materials or resources, accommodations for online courses, assistive technology, and structural accommodations in residence halls (National Center for College Students with Disabilities, n.d.). Accommodations for online courses include extended testing time, flexible assignment deadlines, recorded lectures and class meetings, flexible class attendance, and online note-taking services (Gin et al., 2022). Assistive technology refers to technologies and services that help people with impairments enhance their functional capacity, and includes

tools, equipment, software, and items that improve, maintain, or increase their capacities (Yenduri et al., 2023). Assistive technologies may not have been originally designed for individuals with disabilities, but they may improve functionality and capacity for any individual. For students with visual impairments, there are multiple screen-reading software options available with varying strengths and weaknesses that attempt to fulfill the learner's needs based upon their level of sight and course material involved (Betts et al., 2013). Additional assistive technologies within course content delivery methods include video and audio playback and organizational structure (Terras, Anderson, & Grave, 2020). Utilizing assistive technology in higher education aids students with learning difficulties remain competitive with their peers, fostering social engagement, boosting self-confidence, and enhancing academic success (Yenduri et al., 2023).

Examples of physical assistive auxiliary aids technologies include Braille calculators, printers, or typewriters, closed caption decoders, open and closed captioning, voice synthesizers, calculators or keyboards with large buttons, raised-line drawing kits, assistive listening devices and systems, and telecommunications devices (U.S. Department of Education, 2021). Minnesota State Board Policy 1B.4, Access and Accommodation for Individuals with Disabilities does not indicate whether the student must return software, hardware, or auxiliary aids at the end of the course, semester, or attendance at a Minnesota State College or University (Minnesota State, 2013). Mitchell and Scigliano (2000) identified four barriers to technology that individuals with disabilities must overcome in the online environment: physical access, intellectual competence, psychological feelings of powerlessness, and technological competence in an ever-changing technological environment (Wattenberg, 2004).

Emerging Technologies and Potential in Assistive Technology in Higher Education

The landscape of higher education is constantly changing as a result of the quick adoption and spread of new technologies in teaching and learning methods (Yenduri et al.,

2023). Historically, people with disabilities, as end users have been missing in the development of assistive technology (Smith et al., 2018). The Rehabilitation Engineering and Assistive Technology Society of North America published a guide in 1987 indicating recommended steps for development of assistive products beginning with product needs identification, leading to product research and development, manufacturing, marketing and distribution, application of products including evaluation and support, finally, measuring the outcome that informs the need for the process and cycle to continue (Smith et al., 2018). Smith et al. (2018) stressed that there must also be a plan for implementing any new assistive technology that includes the user needs and goals, product and services. Ultimately, the appropriate use of assistive products and technology must be matched to the user, activity, be context-sensitive, and due consideration made for the social and physical environment in which it will be used (Smith et al., 2018).

Artificial intelligence and human-computer interaction have played a significant role in supporting students with disabilities and will continue to develop as research progresses. Internet of things (IoT) as an assistive technology enhances voice and vision, and also provides real-time data on various challenges faced by students with disabilities by using sensors to track behavior patterns and successes (Yenduri et al., 2023). Augmented reality and virtual reality have the potential to assist students with disabilities engage in physical and educational activities as well as social integration. The use of the metaverse in inclusive education allows students with disabilities to experience historical sites or conduct experiments in a secure, virtual setting alongside their classmates, allowing them to concentrate on their education without worrying about accessibility issues (Yenduri et al, 2023).

Benefits and Drawbacks of Advancements in Assistive Technologies in Higher Education

The benefits of assistive technology in online courses in higher education extend beyond students with disabilities. A 2022 EDUCAUSE report found that students, even those not reporting any disability, indicated that they need or appreciate

assistive technologies, such as closed captioning on videos, pausing videos for notetaking, or rewatching recorded lectures (Jenay, 2022).

A class action suit was brought about by the National Association of the Deaf, three identified plaintiffs, and the proposed class of all individuals who are hard of hearing or deaf who wished to access online Harvard Platforms (National Association of the Deaf on behalf of its members C. Wayne Dore, Christy Smith, Lee Nettles, and Diane Nettles on behalf of themselves and a proposed class of similarly situated persons v. Harvard University, and the President and Fellows of Harvard College, 2019). Harvard Platforms include all free, open-access videos, podcasts, or other materials through 13 different websites, webpages, YouTube channels, or other media. The parties settled out of court, with Harvard agreeing to provide accurate closed captioning for all online media content as well as provide industry-standard live captioning for school-wide events that are live-streamed, while captioning new content of department sponsored student organizations, massive open online courses and new content on its official channel hosted by third-party platforms, including YouTube, Vimeo, and iSoundCloud (Disability Rights Education & Defense Fund, 2019). The positive impact of this settlement has had far-reaching impact, as all institutions of higher learning that receive Federal financial assistance will also need to provide accurate closed captioning or sign language interpretation for open-access online content, both recorded and live. A negative impact of this settlement was the University of California, Berkeley removed more than 20,000 free, open-access video and audio lectures because the institution determined it was cost prohibitive to make them accessible (Baldwin & Chiang, 2021). Development of accurate, cost-effective closed captioning technology may incentivize institutions such as the University of California, Berkeley to caption and restore open-access materials for the benefit of all, not only those who are hard of hearing.

With any technological advance, access and availability are central issues. For example, while augmented reality and virtual reality have tremendous potential as assistive technologies for students with disabilities, a 2019 EDUCAUSE

report indicated that only five percent of community college students and four percent of four-year university students had access to AR/VR headsets owned by the institution (Gierdowski, 2019). Factoring in auxiliary devices students may use (such as mouth sticks, hand wands, adaptive keyboards) when designing online courses is a key to access as well – online courses should be designed that do not require mouse movements to navigate (Baldwin & Ching, 2021).

Implementation barriers with respect to educational technology are categorized as being external or internal (van Halem et al., 2020). External barriers to technology integration are described as being extrinsic to students, including lacking information and communications technology infrastructure (e.g., mobile devices such as laptops, notebooks, tablets, smartphones, etc.) and inadequate support structures (van Halem et al., 2020). Internal implementation barriers are intrinsic to the student and include negative beliefs about learning and educational technology, lacking motivation or perseverance and unwillingness to change (van Halem et al., 2020). Students with disabilities have their own unique internal implementation barriers due to their diagnoses.

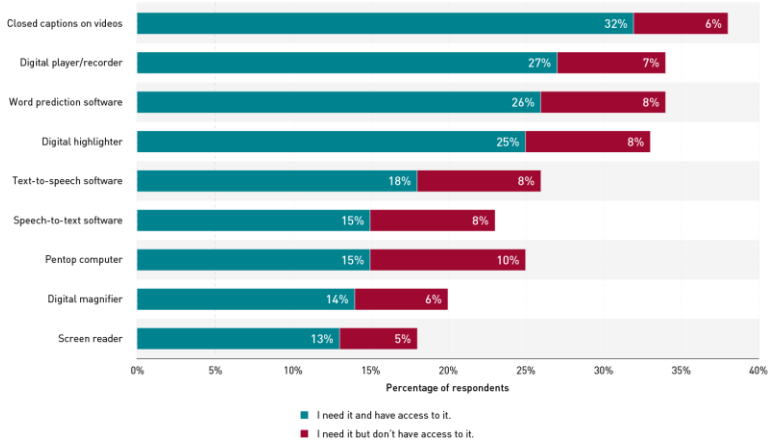
Skills and Knowledge Necessary for Professionals and Institutions to Adapt and Thrive Using Assistive Technology

Without specific guidance from their institution, college and university faculty may not be familiar with Section 504 or ADA requirements regarding to use of an auxiliary or personal aid in their classrooms or software to be implemented in online courses; even if they are familiar with ADA compliance, they are still required to adhere to regulations (United States Department of Education, 2021; Becker & Palladino, 2016). Faculty must implement accommodations, whether it is software or use of auxiliary aid, as notified by their institution's disability services office, unless they are able to provide evidence such accommodations change the academic standards or rigor of a course by lowering or substantially modifying essential requirements of the course (Bain De Los Santos, Kupczynski, & Mundy, 2019). It is the faculty member who interacts directly with students in the classroom and can make the greatest impact

on or become a barrier to student success (Becker & Palladino, 2016). When faculty have more contact with students with disabilities, they are then more willing to accommodate and modify teaching in their classrooms; on the other hand, when students feel that faculty members are not aware or sensitive to their needs, they feel intimidated and rejected (Bain De Los Santos, Kupczynski, & Mundy, 2019).

Institutions are legally mandated to follow the Americans with Disabilities Act and Section 504 of the Rehabilitation Act in supporting and accommodating students with disabilities. While it is not possible for a single assistive technology to be a universal solution to the challenges faced by all higher education students, institutions, instructors, and developers can work together to develop technologies that can benefit large populations of students (Yenduri et al., 2023). Institutions must also require instructors to better understand the needs and supports for students with disabilities, monitor instructor compliance with disability accommodations, and help create communication pathways between instructors and disability service coordinators (Gin et al., 2022). There must be a connection between students with disabilities and the institution they attend. In higher education, a student must register with the disabilities services office to request accommodations (Minnesota State, 2013). Institutions must be aware of the assistive technology needs of students and provide them at no cost to the student when part of their accommodations (Minnesota State, 2013).

The 2022 EDUCAUSE Students and Technology Report determined that there are gaps in students who require specific assistive technologies and have access to it and students who need specific assistive technologies but do not have access to it:



(Educause, 2022)

Similarly, companies and organizations who develop assistive technologies should include individuals with disabilities in the research and development of their products to ensure the device or software meets the needs of their intended user, as assistive technologies work best when they are matched to the needs and goals of the user (Smith et al., 2018).

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Emerging and Expanding Educational Technology in K-12 Education

Matthew P. Huettl

Innovations in technology have made many aspects of our society unrecognizable from 20 years ago, and their impact on specially designed services for students with disabilities is no exception. Technological advancements are challenging current methodologies for planning instruction, teaching, and supporting students with special needs. From assistive and augmentative communication (AAC) devices and Artificial Intelligence (AI), these advancements are shaping the future of special education in ways that were never imaginable. By designing instruction around the needs of the learner and fostering inclusivity through accessibility, which creates the conditions for communication and independence, technological advancements are enabling those with special needs to overcome challenges, create new pathways that lead to new opportunities, and participate more fully in society. This paper will explore leveraging technology in special education by building the reader's understanding of technology advancement, how technology can address inequitable barriers for students with disabilities, limitations of technological growth for K-12 special education, and policy considerations.

The Current State of Technology in K-12 Special Education

AI is one technological advancement that has the propensity to revolutionize K-12 education and influence every aspect of our existence as human beings. In the ever changing landscape of special education, AI enables educators to reimagine how students with disabilities are taught and learn, paving the way for more personalized learning experiences which will increase accessibility to a majority of our most vulnerable learners (Hinojo-Lucena et al., 2019). Akagi et al. (2019) suggests thinking of technology such as AI as a means to imitate human intelligence. Through AI technologies such as ChatGPT (Generative Pre-trained Transformer) students with disabilities can process vast amounts of data and ask intuitive questions to make informed decisions. According to Ortiz (2023), Open AI

developed the language model called ChatGPT. It is designed to produce written words or picture responses given a prompt or a conversation. Some of these responses can be in the form of emails, sentences, paragraphs, coding, or rendering images. Ortiz (2023) elaborates that ChatGPT analyzes data from the internet, allowing it to understand user questions to produce a response. From an initial glance, AI looks promising to enhance educational outcomes, fostering critical thinking skills and preparing students for future challenges, Yilmaz (2023). As AI's capabilities and understanding grow, it becomes more apparent that AI will soon become an indispensable tool in K-12 special education classrooms that empowers educators, engages students, and unlocks new opportunities for teaching and learning. Even though there are many uses in public education, including answering questions, providing explanations, creating content, assisting with language translation, and engaging in interactive conversations, it is essential to note that ChatGPT is still a model that may sometimes produce inaccurate information that can confuse the end user or lead the user down the wrong road.

In my journey of capacity building as an AI novice, I was fortunate to come across a website that provides a comprehensive and accessible overview of AI technology. As a practitioner, it is essential to understand that they must balance existing information with new information, which seems like it is being produced daily. Therefore, it is nice to have a recognized leader in the industry, such as The Association for the Advancement of Artificial Intelligence (AAAI) website, with being the premier resource not only for accessible PDF magazines but also the host organization for international conferences and symposiums regarding AI. The AAAI website offers many other resources covering leading-edge topics for AI, including articles, tutorials, research papers, and educational materials. The website also features news updates, conferences, and events related to AI, making it for those seeking to understand AI.

In special education, other technology tools such as communication applications (apps) are vital in promoting

communication and enhancing social interactions for students requiring specially designed instruction. These apps have conveniently set the enabling context for both educators and therapists to have the tools and resources to equitably provide students with more opportunities to be independent learners. Educational apps have evolved for at least the last decade and continue to do so daily. Communication apps provide augmentative, alternative communication (AAC) tools or devices for students with speech or language impairments. AAC is often referred to as Assistive Technology (AT). An example of an app that does this is Tobii Dynavox, which is significant because a company like Tobii Dynavox has such a small market for a buyer to choose from for this type of software that serves the entire world as the sole proprietor. These apps often include visual supports and customizable communication boards, allowing students to independently communicate their needs, thoughts, and feelings. Ultimately, these tools provide more opportunities for students to access their education, peers, and social-emotional support. Another popular AAC tool is the Picture Exchange Communication System (PECS). Overall, the PECS system was around even when I graduated from college, but since then, they have continued to evolve and refine their product on what seems like a yearly basis. PECS apps use visual symbols to facilitate communication. They allow students to construct sentences or requests by selecting and arranging relevant symbols on a digital communication board. Often, if an app is being used, the student is most likely using the app on an iPad. Lastly, another communication app often used in school districts is Voice Output Communication Aid (VOCA). VOCAs can be used as stand-alone devices or with an app on an iPad. They offer advanced features such as message banking and symbol-based communication for students who cannot communicate independently or need some support.

Lastly, the writer will briefly overview Text-to-Speech (TTS) as an AT. TTS technology converts written words into spoken words, characterized as a synthetic voice. TTS is equally important as AI and communication apps because it is another technological advancement that improves access to a student's least restrictive environment (LRE), a rigorous curriculum, and

outcomes for students with disabilities. Bar-Lev & Huettl explain, "Text to Speech technology, which reads digital text aloud, provides instant access to all sorts of instructional materials including textbooks, articles, websites, newspapers, and even instructional materials prepared by the classroom teacher" (p 11). Unfortunately, since the reauthorization of the Individuals with Disabilities Act (2004), many schools across our nation are not using these types of tools for students with low-incidence disabilities. According to Bar-Lev & Huettl (2021), TTS is an AT that provides auditory output for the written word (primarily computer-based), allowing individuals to listen to text-based information instead of decoding the written word. One example of a TTS system is Snap and Read from Don Johnston, which analyzes written text and uses synthesized voices to generate the spoken output. Through TTS systems such as Snap and Read, students can more readily access the grade-level curriculum and engage with digital content as their peers, fostering a more inclusive environment. Bar-Lev & Huettl indicate, "Providing Text to Speech for students is also an education equity issue, ensuring that every student has access to the educational resources and rigor they need at the right moment in their education" (p 11).

How Technology Can Address Inequitable Barriers for Students with Disabilities

Using technology to improve educational outcomes for students with disabilities can be pivotal in addressing the principles of Free Appropriate Public Education (FAPE) and the Least Restrictive Environment (LRE), as outlined in the Individuals with Disabilities Education Act (IDEA). The reauthorization of IDEA promotes inclusivity among our nation's most vulnerable citizens. This passage of IDEA has systematically dismantled systemic barriers and prejudices to take steps closer to our nation's schools to cultivate a culture that embraces diversity, equity, and respect. Nepo (2017) explains in detail that our vulnerable learners are entitled to the same fundamental rights as their non-disabled peers, which helps ensure they have equal access to FAPE. The regulatory mechanisms of IDEA to enforce FAPE have shifted the

pendulum for students with disabilities by providing them with appropriate accommodations, support services, and specially designed instruction to participate in their LRE. Educators that take the time to learn about technology advancement create opportunities for students with disabilities to experience a more inclusive and accessible learning environment, which ensure students with disabilities receive FAPE and have opportunities to participate and thrive in their LRE. This thought process is supported by the work of Ojha (2022) when she indicated that incorporating AI tools in educator pedagogy could enhance K - 12 systems to enhance efforts to meet IDEA mandates such as FAPE and LRE by supporting online education, including personalized student learning, automated instructions, assistance with routine tasks, and powering adaptive assessments through accommodations. Implementing technological advancements such as apps for students with disabilities can positively address inequitable barriers through educational access. Ultimately, Cardona et al. (2023) support these sentiments when they indicate that AI may allow educators to educate students where they are and build on their strengths. In K-12 special education, students with an Individualized Education Plan (IEP) require specially designed instruction with appropriate accommodations and modifications.

With technological advances such as ChatGPT, educational practitioners and researchers find that individualized instruction for students with disabilities can be met through this means of instruction. Frackiewicz (2023) writes that ChatGPT can provide individualized support for students and adapt to their learning needs by offering customized explanations, examples, and resources. In a different article, Frackiewicz (2023) states that ChatGPT can also increase multi-sensory learning by presenting information in various formats, such as text, imagery, and audio, which allows students to interact with content using different modalities, which in theory should enhance learning outcomes. This is significant because substantial research shows the positive results of Universal Design for Learning (UDL), in which ChatGPT can strengthen multiple forms of representation. For students with communication and language development needs, Frackiewicz indicates that ChatGPT can assist by

enabling students to engage in bias-free conversations, providing instant feedback on grammar and vocabulary, and encouraging self-expression. According to Akagi et al. (2019), "harnessing the capabilities of AI tools can accelerate the progress in serving individuals with complex communication needs who require AAC" (p 12). Lastly, one of the most remarkable features of ChatGPT is the integration of text-to-speech software. This is a game changer for students who require specially designed instruction. For example, Valenzuela (2023) writes that integrating text-to-speech or speech recognition software and ChatGPT enables students with reading or writing disabilities to interact with the content, access instruction, and promote independence. This has the potential to provide unlimited access to curriculum and instructional materials and participate with same-age peers in a less restrictive manner.

Limitations of Technological Growth for K-12 Special Education

Over the last century, technology has advanced faster and further than most people could have imagined. The current state of technology growth is the same when one tries to imagine what is next for AI in today's K-12 system. Educational leaders in higher education and K-12 systems must plan for AI integration into our educational institutions. AI can open numerous possibilities, but the United Nations Educational Scientific and Cultural Organization (UNESCO) (2019) highlights it can also be disruptive if not managed appropriately since it has the propensity to deepen marginalization among vulnerable populations. The digital divide becomes real when one considers the lack of resources available for school districts primarily serving students from low socioeconomic backgrounds. UNESCO (2019) points out that this type of technological growth could increase the marginalization in communities that need more technical infrastructure, resources, trained teachers, or funding to support this type of growth.

This exacerbates the digital divide between more affluent and less affluent communities. Teacher training must occur for AI to be successfully integrated into today's classroom.

Fortunately, there are already forms of AI being integrated into classrooms across our nation, but unfortunately, there is a teacher training gap. That gap will be even more significant depending on the school district's location. UNESCO (2019) states that without the appropriate training, teachers may find it hard to keep pace with technological growth, such as AI because they do not know how to plan, integrate, and implement this new technology because of the lack of professional development opportunities, which only permeates the gap between what students need to learn and what educators are capable of teaching. In his study, Moreno (2022) also found the importance of professional development, which confirmed the conclusions from previous research that high-quality professional development for educational practitioners is essential forsuccessful technology integration for student learning. Lastly, integrating technology into school systems with low academic achievement, a high number of low socioeconomic students, high staff turnover, unfunded, or any other type of dysfunction will still perpetuate these barriers, even with the introduction of AI. The US Department of Education (2023) states that AI can do great things for school systems but cannot address systemic school issues plaguing many K-12 educational systems.

Policy Considerations

To successfully implement technological advancements such as AI into schools across the United States of America, it will be necessary for both federal, state, and local school boards to initiate policy recommendations. With this oversight to provide left and right limits on a course of action, school systems could avoid unsuccessful implementation, stakeholder skepticism, or perpetuation of the digital divide. Fortunately, the US Department of Education Office of Technology has released a guiding document as the starting point. By releasing this report, The US Department of Education (2023) seeks to bring together all types of stakeholders that have their hand in working directly in schools, support schools, or have some degree of influence in schools in order to engage in addressing the looming policy issues facing our educational institutions. To start somewhere, Bowen (2023) indicates that the ethical use of AI should be

written in Acceptable Use, Ethical Use, and Digital Citizenship policies that explicitly address AI in today's public school systems, which address student privacy, data security, and discrimination. By ensuring that school AI systems are designed to protect student privacy, maintain data security, and avoid biases or prejudice. A school district can have all the policies in place for AI, but what policies are in place only matters if students have access to them.

According to the US Department of Education (2023), school district policy must encompass equitable access to the district's technological advancements, such as AI tools and resources. It will be pivotal that students who live in low-income housing, have a disability, or speak English as a second language have the same access to this technology as their peers; otherwise, this will only perpetuate the digital divide. If school policies account for acceptable use and access, our curriculum policies must address curriculum integration. According to UNESCO (2023), our school policies need to examine the integration of AI into the district's curriculum, which involves developing guidelines or standards for AI education and providing professional development opportunities for teachers to teach AI concepts effectively. Once school districts have the curriculum, they should implement efficient accountability systems. Interestingly, UNESCO (2023) suggests that school policies should be transparent and explainable to all stakeholders in assessment and grading.

In conclusion, technological advancements can potentially increase teaching and learning outcomes for students with disabilities. These enhancements allow learners to access educational materials to become more independent when using tools such as AAC, AI, and communication apps, which foster self-determination. Technology advancements teach students the essential skills of digital literacy and the technical skills to navigate tools and platforms, which will prepare them to be successful in postsecondary school and today's workforce. For students with special needs to succeed in today's workspaces, they must learn to use technologies such as AI and AAC to facilitate communication, enable seamless collaboration, and

foster stronger relationships. However, addressing challenges related to accessibility, data privacy, bias, and maintaining the human element is crucial for the effective and equitable implementation of these technologies in special education. Lastly and most importantly, technology advancements empower schools to provide innovative and inclusive education for our most fragile learners by preparing them for success in a evolving digital and technology rich landscape.

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Blockchain Utility as a Student Information System

Dillon Martinez
with contributions from Christopher Dufault

Student Information Systems (SIS) are the virtual backbone of the modern educational system. These systems play a crucial role in streamlining administrative processes, enhancing communication with both students and parents, and improving data management in schools, colleges, universities, and other educational organizations. The challenge, then, lies in negotiating the vast number of SIS available on the market, with over 300 different options available to keep track of some 49.5 million students in the U.S K-12 system (Fast Facts: Back-to-school Statistics, 2022). Considering these challenges, a need emerges for a universal system to address these complexities effectively, safely, and in a cost-effective manner. It is time to consider blockchain technology as an SIS for the PK-12 system.

Blockchain technology was originally created in 1991 to attest to the who, what, where and when of digital documentation and actions (Park, 2021). Since then, the countdown to implementation on a global scale has been getting closer to zero hour. The financial sector has embraced the use of smart contracts to complete monotonous tasks associated with banking and tax processes (Taherdoost, 2023; Rouhani & Deters, 2019; Sklaroff, 2018), the shipping industry has used blockchain as a ledger to expediate the shipping process (Jović et al., 2019). For example, Lakkakula, Bullock, and Wilson have demonstrated that implementing blockchain in commercial use can reduce the time to process documentation from 7-10 days down to a single day (2018). To achieve similar time savings in documentation processing, the education system should follow suit to help manage the information of our preschool through 12th grade students.

Blockchain Utility as a SIS

In their article titled Blockchain Technology Applications in Education, Atienza-Mendez & Bayyou (2019),

describe blockchain as being decentralized and persistent, while providing anonymity, security, and auditability. These characteristics make blockchain an ideal candidate to help solve the issues posited by a traditional SIS.

To understand how blockchain could be implemented as a better tool for student information management, watch this 6-minute video as a primer on how blockchains work:

How does a blockchain work – Simply Explained

Quick link to video:
https://www.youtube.com/watch?v=SSo_EIwHSd4

This article will use the Special Education Process (SPEDP) as the use case example. This process is rife with sensitive student information, middlemen, and geographically diverse end users; therefore, offering a solid opportunity for blockchain to show its potential.

Decentralization

Blockchain is decentralized, meaning no one person or entity controls the chain, or more importantly, the individual blocks of information that make up the chain. This is useful to the SPEDP because it can hold all parties accountable for the recommendation of evaluation, the collection of parental consent, the initial evaluation, creation of the Individual Education Plan (IEP) documentation and meetings, the implementation of the IEP, along with re-evaluation of the students. Each time any one of these steps occurs, it would be added to the student's profile, validated by independent nodes, and then embossed forever into the blockchain through consensus of the system. It can then be viewed by the parents to see where their child is in the SPED process, the members of the IEP team can all be on the same page and held responsible for their role in the process, and ultimately, the student will be ensured an appropriate education.

Persistent

Once a block is finalized, it cannot be changed or tampered with, and is accessible by anyone with access to the chain (more on types of access later in this article). This "always up" nature of a blockchain (Shrimali & Patel, 2022) enables students who transfer to a new school district to pick up right where they left off with their IEP. The new school district would have instant access to the student's IEP profile without having to wait for the previous school district to send it, which traditionally could take as long as a year to process. To understand the role of middlemen in traditional processes versus one that can be improved with blockchain implementation, please watch this video:

Blockchain and the Middleman

Quick link to video:

https://www.ted.com/watch/ted-institute/ted-bcg/blockchain-and-the-middleman

This feature would also help in lowering the SPED teacher burn out rate. If SPED teachers were able to implement already made (and legally binding) IEP documents immediately upon gaining a new student on their caseload from another school, they would not need to create an entirely new IEP from scratch.

Anonymity and Security

IEP documentation contains sensitive information pertaining to students and families. Alammary et al. (2019), concluded that blockchain is an appropriate way to securely share student data, all while lowering cost and enhancing transparency. Names and other identifying information would not necessarily be needed on the actual chain. Each student or family could be given a numerical ID then they would give to a new school district that could be used to identify individual student profiles. This way no one who has access to the chain would be able to put a name to case number unless they were explicitly given the ID number and permission by the family.

Pertaining to security, there are three main types of blockchains: public, private, and permissioned (Steiu 2020; Zheng et al., 2017). Public blockchains are open to anyone and provide a truly decentralized means of data storage and authentication. Private blockchains are owned and maintained by a single organization, possibly the Department of Education in this case. Due to the nature of inter- and intra-state educational organizations, the optimal blockchain model would likely be permissioned. Within the permissioned genre of blockchains, there are three subcategories: permissionless, semi-permissioned, and permissioned (Qin & Gervais, 2020). Permissionless is open to anyone (similar to public but still needing some form of validation) to both view and verify the data housed on the chain. Semi-permissioned blockchains house data that can be accessed by some but not all—meaning you only have access to the data that is pertinent to you. Lastly, with permissioned blockchains you have full access to all of the chain, but need to undergo a full validation first (Steiu, 2020). The security options available through the use of either a private or permissioned blockchain should give the educational system confidence that it can be trusted to protect the information housed within it, while offering easy access for those who might need it at a moment's notice.

Final Thoughts

Blockchain offers many advantages over a traditional SIS. Blockchain's decentralized nature does away with the central server model and eliminates the need for a middleman—or the possibility of a single point of failure. This enhances the security of the data as a it cannot be hacked in the same way a third-party provider can, while also enhancing the reliability of access of the data as it cannot crash (Shrimali & Patel, 2022).

Blockchain data is immutable and transparent. Once data is recorded on the blockchain, it becomes immutable and cannot be changed once it has been validated. This ensures the integrity and authenticity of student information, promoting transparency and trust in the system (Gräther et al., 2018).

Blockchain also offers complete data ownership and control. With a blockchain-based SIS, students (and their legal

guardians) can have ownership and control over their own academic records like never before. They could grant access to educational institutions or potential employers, providing a more secure and efficient way to share credentials to interested parties, doing away with the expensive transcript process. Students should not have to pay to show their data (grades) to potential employers (Sahoo & Halder, 2020).

Finally, blockchain offers long-term data storage and accessibility. Blockchain's design ensures that data is stored securely and perpetually. This is particularly valuable for maintaining records that need to be preserved for the long term, such as academic transcripts, degrees, or proof of services provided (Banavathu & Meruva, 2023). If we could offer students, their families, and their support SPED professionals the ability to optimize the way in which records of their hard work can be maintained with top-notch data integrity and how it can be most expediently and safely shared with key stakeholders, shouldn’t we at least consider the use of blockchain technology for this purpose?

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Technology Benefiting Project Based Learning

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Less than 30 years ago, technology in the classroom was the newest set of encyclopedias and an overhead projector. Technology, like education and society, has grown exponentially since then. Technology and collaboration have become the flip sides to the same coin. Since the days of rows and desks in perfectly centered lines, we have emphasized collaboration between students, wherever the student may be. The global pandemic in 2020 pushed collaboration and technology together at a rapid pace. We have seen a shift in how education has brought students together in learning. Project Based Learning (PBL) is a shift in education that can connect students to a life that they are more prepared for. This shift can be an effective tool to create authentic collaboration and effective technology use.

Project Based Learning is effective for both learning and collaboration and the appropriate use of technology. In project based learning, students have a goal of collaborative success. The common goal allows students to reflect on their learning via the projects (Kokotsaki, 2016). Unlike traditional class learning, the project helps students to understand what they are learning and talk to each other about it. With the help of technology, such as search engines, AI, and research databases, students can work together to evaluate and reflect on the information. This engages students to practice social skills and application of content. In 2005, John Mergendoller and John Thomas interviewed 12 teachers to talk about the PBL process and came up with a lot of informative pieces that relate to technology (p.29). They discussed that technology could be used to find experts around the world on the topic they are researching. This is important for students' growth. This takes the learning directly off the students and teacher. It gets other people involved to be successful in their goal. While interacting with each other, the students learn more appropriate social skills. When this was studied by Dabae Lee, Yeol Huh, and Charles M. Reigeluth, they used

questionnaires to gauge students' thoughts on conflict, collaboration, and social skills (Lee, 2015). Students completed tasks and then their responses on how the task went were coded. They determined that when students are actively engaging in projects, they are learning how to address conflicts while in these situations. Students need to be doing 'the work' of skills building in order for it to be productive. Skills must be practiced in situations that make actionable responses. These may have to be regulated and discussed through the teacher, but the students can learn how to deal with all types of people. Even though technology can put distance between people, it can connect students in the classroom.

With this format of learning, we can better integrate it with technology. Technology has been important in showing complex systems while helping educate students. An example of this is zygotebody.com. This website allows students to see all aspects of the body in different layers. These layers can be toggled on and off to determine how other systems affect one another. Students can see all the systems of the body working together. It promotes inquiry learning to explore the body and communicate science information effectively. Students use the system to collaborate and discuss the human body. This is authentic learning between those engaged. Technology can drastically improve the ability to model abstract concepts. PBL experts Joseph Krajcik and Phyllis Blumenfeld discussed that model building creates a connection of complex systems, but helps students understand at a deeper level (Krajcik, 2006, p. 327). Technology helps show these complex systems in simple ways in order to naturally scaffold information to students. Phet simulations from University of Colorado- Boulder (Wieman, 2008) does a great job of doing this. Their simulations can be used as labs that test real life situations which allow students to engage in lower level physics and work their way up to higher end material. All programs allow students to work through labs in a structured or inquiry based setting. This again helps take the responsibility for learning off the teacher and pushes it more on the student. As education integrates with effective technology, we will see a swing toward complex models to influence project based learning.

Project Based Learning encourages students to develop more application artifacts. The application piece is a keystone in PBL. The genuine application not only creates better products from students, but the application can have direct connections to future careers. A study conducted by Beier et al, looked at the effect of PBL on career aspirations. The study showed that there is a direct connection between student engagement and career interest in a selected topic (Beier, 2018, p.20). Since high school is about discovery of the future, this helps students see various paths that they could take. This application is not done to perfection overnight. It must be taught just like any other subject. John Larmer and John Mergendoller of the Buck Institute of Education discussed how the teacher acts as a coach to "coach them to add to this list as they discover new insights" (p. 36). The application is learned but becomes expected of the students. These expectations develop new learning and insights to improve student learning. Technology can be used to find key information, share content, and have direct connections to various aspects of learning. Jamboard by Google is an effective way for students to show their learning and develop artifacts that share their learning past facts and figures (Sweeney, 2021). In the studies example, they showcased an anatomy classroom process of going through body systems that allowed students to become the experts and share their information effectively. Technology helps learners go past typical problem solving that helps create complex solutions.

Overall, PBL helps all students learn at higher rates. A study was done by Margit Kastner that looked at PBL in a large class context, "PBL & PA can foster academic excellence and better prepare future leaders so that they can meet expectations set upon them" (Kastner, 2020, p. 59). It was shown that this form of learning and assessment can drastically develop students much better than other methods. Comparing 'clicker questions' to PBL learning, there was a large divide of learning between these two methods. Not only would a unit of a classroom curriculum need to be adjusted to follow this PBL format, but a class would need modification. Technology would allow a curriculum to be evaluated easier to benefit this format. Project Based Learning helps not only scores but helps develop a higher

level of learning. Technology helps connect the two together to benefit academic success.

Even though PBL has great benefits, not everyone sees it this way. There can be drawbacks to this system. Many new educators to this system struggle to implement this in their classroom. Instead of choosing technology to benefit the projects, they will give projects and hope the technology works out. Students were allowed to engage in projects related to engineering tasks. According to Tseng and Chang, a study was conducted looking at attitudes toward STEM while completing PBL tasks and "engineering knowledge is complex and difficult to learn" (Tseng, 2013). Over time, this did change, but in the initial moment of learning a complex task students struggled. This struggle is important since it develops a better understanding of content. If the technology is ineffective and ambiguous, the project is compromised and becomes 'group Google time'. Despite emphasis on application learning and content reflection, the assignment just looks like busy work and not project based learning (Meikleham, 2018, p. 13). When this happens, students revert to their old view of the instructor. They see the instructor as someone to give out homework and just check the boxes of learning given by the district. Technology is not effective in these situations. When not used properly, technology becomes a distraction. Students have no guide to learning, which in turn gives no guide to the technology. Even though PBL and technology can work hand in hand, it may not be truly effective if not given the right direction.

As education and technology change, students' learning will follow. With technology and education working together, the face of education has started to change. Education is not as focused on facts and small pieces of information, but instead focused on application of content and in depth practice of learning. Technology will help develop these practices in order to drive this path of education. In the current state, project based learning is all about taking a piece of technology and using it to develop learning. As this curriculum changes and integrates into many other classrooms, technology will become more interdependent of the application instead of the facts. Artificial

Intelligence (AI) in all capacity has caused a direct change in PBL so far. There are many programs that can spit out projects given a prompt. When creating the projects that encourage learning, educators need to be specific in prompts that promote learning and not make it an AI challenge. There are plenty of ways around this, but it is important to consider. Various technologies in education will change how projects are developed. Lih-Juan ChanLin who studies library and information science, discussed that there must be an important curriculum developed in order to correctly integrate technology to promote inquiry and critical thinking (ChanLin, 2018, p. 64). No matter the technology that comes through the K-12 school system, it will be important to integrate technology appropriately within a PBL system. Education and technology will always be held together in a similar standard. It is key to have success for both as professionals adapt and thrive in the K-12 system.

Throughout time, technology has changed drastically. Education has been trying to keep up while educators figure out what works best for students. Project Based Learning has been peeking its head through classrooms for many years now, but technology has made it even more pertinent in society today. PBL and technology has been shown to help students develop better critical thinking skills, social skills, and academic growth. As technology grows, education will too. PBL and technology will continue to find ways to integrate into one another to help students learn for the future.

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Education Doctoral Program
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ISBN: 9781948397100