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Reimagining the Future of Special Education Technology

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Introduction

The field of special education technology is focused on applications of technology that serve to augment, bypass, or compensate for a disability (Edyburn, 2013). Within this discipline are three specialty areas: assistive technologies, instructional technologies, and/or universal design for learning.

Historically, any technology used by a person with a disability has been thought of as *assistive technology*. Federal law defines an assistive technology device as follows:

> …any item. piece of equipment, or product system, whether acquired commercially, off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability. (20 USC § 1401(1)(A))

Some experts have argued that the definition of assistive technology is so broad that it could include anything (Edyburn, 2004). In fact, that is a simple way to think about it: Assistive technology is *anything* that improves the functional performance of an individual with a disability. Because of the potential assistive technology holds for individuals with disabilities, federal law requires that assistive technology be considered when planning the Individualized Education Plan (IEP) for every student with a disability.

Instructional, or educational technologies, are those technologies used in schools to promote learning (Roblyer & Hughes, 2019). For students with disabilities who have difficulty learning, specialized instructional technologies may feature detailed feedback and error analysis, branching, simplified language, and personalized learning. It is

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often difficult to discern in advance whether or not an instructional technology will be effective for a student with disability in achieving a given instructional objective. However, the inability to learn academic content in the same way, or at the same pace as peers, is a key characteristic of a disability and therefore should be considered when selecting instructional technologies to support diverse learners (Edyburn, 2019).

Universal design for learning (UDL) is an approach to instructional design that embeds supports for learners before they are needed (Meyer et al., 2014). That is, learners may use a slider to adjust the font size to enlarge the text to a comfortable reading level, turn on closed captions to make audio information accessible, or use text to speech tools to foster comprehension of text that could not be read independently. The value of UDL is that these design features not only help students with disabilities but also have the potential to help many students in the general classroom.

For the foreseeable future, it is appropriate that educators focus on these three types of technologies that are well-known within special education. However, there are larger trends and issues impacting the world around us that have profound implications for the future of education in general and special education technology specifically. The purpose of this chapter is to re-imagine the future of educational technology applications for individuals with disabilities, a population that represents 10–14% of school-aged children (National Center for Education Statistics, 2021).

Process

Technologists often focus on the latest advances being made in research labs or new entries in the commercial marketplace by making it a priority to stay-up-to-date with the latest technology trends and issues (Future Today Institute, 2022; Pelletier et al., 2022). However, just knowing about new technologies is not enough for educational leaders because there is little guidance about how or when a new technology trend will emerge into a force that has significant impact.

Futurists often describe three types of change and the types of impact that is produced (Burrus, 1994, 2011). *Incremental change* is predictable, involves little risk, and enthuses a high degree of confidence that the scenario will become a reality. A second type of change occurs when two different trends come together in ways that accelerate the effect of the change. Seeing relationships that foster *convergence change* requires a bit of vision and creativity, because the ability to connect dots is not readily apparent to everyone, yet. However, research has shown that when a business harnesses *disruptive change* technologies, it is not necessarily the first or the one with the best technology that achieves market dominance (Christensen, 2013). Rather disruptive organizations prosper because the rules of the game changed while others were still playing by the old rules. Analyzing change using these three techniques from the work of futurists can provide educational technology leaders and educators with keen insight about planning for the future of education during a period of rapid change.

To connect the dots between factors that could significantly alter the future of special education, two sets of variables are worth considering. Table 1 illustrates 13

Table 1 Pandemic influenced trends and issues impacting the future of special education

Trend & issue	Description
Accountability	Emphasis on monitoring student attendance, engagement, and achievement of grade level learning standards. Accountability measures can be targeted at multiple levels: Classroom, school, district, and/or state. Accountability initiatives were often modified in favor of flexibility given the unprecedented nature of the pandemic
Assessment	During the pandemic, high-stakes assessments were often suspended. As a result, little normative information is available concerning student achievement. Formative assessment will continue to be important while new initiatives are created for benchmarking student achievement and are re-instituted or re-designed
Classroom demographics	American classrooms are more diverse than ever before. Educational systems will be challenged to diversify its teaching staff
Effective practice	Recent research has focused on high leverage practices. That is, research-based practices that have been demonstrated to increase student achievement. Now that such practices have been identified, how do pre-service and in-service teachers learn to implement these practices in their classroom during and after the pandemic?
Engaged learning	Pedagogy continues to shift from teacher-centered classrooms to a focus on learning engagement. During the pandemic, concern about student engagement became a critical concern. Engagement is essential for learning
Equity	The pandemic revealed many structural inequities that disproportionately impacted students of color, students with disabilities, English language learners, and students living in poverty and their families. Federal American Recovery Plan funds have been distributed to assist educational leaders in addressing structural inequities
Learning loss	What can be done to reduce/eliminate the learning deficits caused by the pandemic? At this point, while initial research studies are emerging, little is known about the long-term impact of learning loss
Mental health	As the pandemic impacts its third school year (2019–2020, 2020–2021, 2021–2022), mental health has become a critical issue for children and families, as well as teachers. Some schools have developed new initiatives to integrate social emotional learning (SEL) into the curriculum
Remote learning	The pandemic required schools to pivot from face-to-face learning to remote instruction. While many teachers, students, and parents were required to learn new skills in order to connect, remote learning is likely to continue post-pandemic as a form of flexibility
Space utilization	During the initial phase of the pandemic, schools were empty. Later, in initial efforts to reopen schools and socially distance, some schools adopted a block schedule where students would attend two days a week (e.g., M & T or R & F) and participate in remote Learning two other days. Similar to the questions raised by business, are there better ways to utilize space?
Teacher pipeline	Enrollment in teacher education programs is down 5–10% which signals we are not preparing enough future teachers to meet current demands – Much less to fill existing teacher shortages. Predictably, a teacher shortage crisis is on the horizon
Teacher shortages	School districts have always faced a shortage of special education teachers. However, teacher shortages in all disciplines, and at all levels, have significantly increased during the pandemic such that certified special education personnel are not available for every classroom
Workforce readiness	Questions continue to be raised about whether K-12 students completing are workforce ready. Increased technology use in the workplace challenges educators to ensure students have the necessary knowledge and skills for 21st college and careers.

trends and issues selected by the author that have received renewed attention during the pandemic and likely have the potential to impact the foreseeable future of education and the provision of special education. Similarly, Table 2 summarizes 13 technology trends and issues that are the routine focus of technology developers and start-up companies and are of interest to educational technology specialists interested in emerging technologies. Readers are encouraged to browse both tables and consider whether or not they have a general awareness with each issue. Ideally, readers will have a cursory understanding of each item, which individually, are likely to be unremarkable at this point. It should be noted that many other topics could be added to these lists. The topics have been selected by the author to illustrate a predictive process that will be described in detail in the next section.

The next section examines the potential convergence of these trends in light of Burrus' (1994, 2011) three types of change in order to understand the influences on the education of students with disabilities in inclusive settings. The goal is to provide the tools necessary to assist educational technology leaders and educators to answer the question: Is it possible to discern the difference between technologies that will produce incremental, and perhaps inconsequential, change with technologies that will produce profoundly disruptive effects in order to plan for the future of inclusive education?

Findings

Burrus (1994) contends that new futures are created from a mix of technological innovations and new rules that change the nature of the game. He uses the metaphor of a card game to illustrate what happens when the game is played by the conventional rules (the future will be similar to life as it is today). However, he periodically introduces new cards and new rules into the game, injecting the appropriate level of chaos that real change brings. (Perhaps you have noticed how hard it is to win a game when you don't know the rules?)

Focusing exclusively on trends may point to predictable change, but new rules and tools can fundamentally alter the ways systems work. Pausing for a moment, isn't this what education experienced during the pandemic? The need to pivot from classroom-based instruction to remote learning? The need to change from paper-based learning materials to digital learning materials? The need for learners to become less dependent on teachers and more self-directed? While educators have debated these issues for decades, did we ever anticipate that such profound changes would be implemented in every school district across the country in a matter of weeks during Spring 2020?

Using the information presented in Tables 1 and 2, I believe it is possible to engage the educational community in a process of recognizing trends in education and technology that may have a significant impact on the future of inclusive education. In the sections that follow, I model the process of selecting a trend from each

Table 2 Technology trends and issues with the potential to impact inclusive education

Trend & issue	Description
1–1	For many years, schools longed to provide each student with a computer (known as a 1–1 program). The pivot to remote learning during the pandemic made this goal a reality as many schools sent students home with a Chromebook. Yet, many teachers, students, and families were unprepared for online learning. Now that the basic infrastructure is in place, what does the future of 1–1 learning look like?
Apps	As smartphones have become ubiquitous, apps have become a necessary tool for mobile professionals. However, in the educational space, apps often have a single function and do not talk to each other or share data. As a result, teachers are required to sign-in and manage many different apps. How will apps of the future be different?
Cloud computing	A key design principle of many cloud computing applications is that they allow users to sign in from multiple devices (i.e., smartphone, tablet, laptop, desktop) to use apps or software and access their data. The backbone that makes this workflow possible is known as cloud storage. What are the implications of cloud computing for the future of education?
Data	It is increasingly possible to collect a wide variety of data explicitly from users (e.g., name, preferences) as well as extract data from their behaviors (e.g., time to respond, correct/incorrect). Online learning may afford additional data such as the user's image, voice, and IP address. At the present time, there are few protections of user data and limited opportunities to opt out. As companies seek to monetize this data, what rights do students/parents have about how student data will be used?
Digital curricula	The pandemic accelerated the adoption of digital curricula. Yet, many learning materials are not much more than scanned PDFs of print material. And, there have been many instances where digital curricula were inaccessible to students who utilized assistive technologies. As schools adopt more commercial digital curricula, what instructional design principles should be put in place to ensure that learning materials are not only accessible, but effective, in producing learning outcomes in diverse students?
Immersive environments	Augmented reality (AR), virtual reality (VR), and mixed reality (MR) are all forms of immersive learning environments. The recent announcement about the Metaverse has renewed attention about the future of this sector of educational technology. To the extent that immersive learning environments are effective in promoting learning, to what extent will these new technologies be adopted and used in schools?
Learning analytics	Given the exponential increase in data collected by software and apps, learning analytics involve statistical methods to make sense of the data. Writing an equation that determines whether or not a student has demonstrated sufficient understanding of an instructional topic is extremely challenging. However, advances in learning analytics will be essential to achieving the promise of personalized learning. At the present time, little is known about what learning analytics can tell us about learning during the pandemic
Learning management systems	Learning management systems (LMS) are designed to facilitate online teaching and learning. In the K-12 space, Google classroom and Moodle are the most common LMS and blackboard the most common LMS in higher education. How might the current generation of LMS evolve in the future to enhance personalized learning and effectively use learning analytics?

(continued)

Table 2 (continued)

Trend & issue	Description
Machine learning	Machine learning (ML) involves statistical analysis to make sense of patterns in extremely large data sets. At the present time, insufficient data is available at the classroom or school level to apply ML. However, when data is aggregated through a LMS with hundreds of thousands of students, interesting problems can be posed. How might ML be applied in post-pandemic education?
Online learning	Prior to the pandemic, online learning was primarily the domain of higher education and specialized advanced placement classes in high schools. The pandemic accelerated online learning into K-12 education with many unanswered questions about its appropriateness for young children. In the future, how will schools deploy online learning effectively?
Personalized learning	Understanding that one-size-does-not-fit all, curriculum developers are increasingly designing learning systems that afford multiple pathways to achieving learning objectives. Whereas individualized instruction was once the purview of special education, personalized learning is viewed as desirable for every student. What advances might be expected in the personalized learning space if remote learning continues or in a return to classroom-based instruction?
Privacy	The increased prevalence of data collection has raised a number of questions and concerns about privacy. While there are several federal laws designed to protect minors, there are few agreed upon student privacy standards. As school districts implement more digital curricula products, what needs to be done so that student privacy is protected?
Security	The pandemic revealed a number of security flaws in educational software and school district server maintenance practices. As a result, student and teacher data has been compromised. As schools become much more dependent on technology-based instruction, what investments need to be made in security systems and user practices to prevent unauthorized access of student data?

of the tables and then use the information to frame a description of a scenario concerning a future that re-imagines education for students with disabilities.

Incremental Change Scenarios

If we anticipate that change will occur slowly and incrementally, then the future will simply evolve from where we are today. Leaders and educators who plan for the future of technology by focusing on a single trend may take action found in the following scenarios.

Scenario #1

Trend Learning Loss

The Future Policymaker and educators have become concerned about evidence that suggests that most students failed to achieve a full grade of academic achievement during the pandemic. Significant questions are raised about the long-term impact of these lost opportunities.

Implications Students with disabilities have been identified as one of several groups that have been inordinately impacted by learning loss during the pandemic. Federal funding allocated through the American Recovery Plan has specifically targeted learning loss as a priority to be addressed through new state and local programs. Schools could choose to use these funds to implement summer school programs or purchase new digital learning materials designed to close the achievement gap.

Scenario #2

Trend Security

The Future As twenty-first century teaching and learning becomes more digital, data breaches will continue to become increasingly common as more student data is collected and stored online.

Implications During the pandemic, ransomware attacks against schools increased dramatically (Cybersecurity and Infrastructure Security Agency, 2020). As a result, schools will need to devote an increasing percentage of their technology budget to enhancing security training and services. (Yet, these expenditures become a significant cost of doing business and yet have no direct relationship to student achievement.) The technical requirements of this work will require external contracts as the expertise is too expensive to employ local personnel. Some security protocols will make it difficult or impossible for some students with cognitive disabilities to independently log-on. Students who use alternative input devices because physical disabilities prevent them from using the standard keyboard and mouse are likely dependent on someone else to sign-in for them.

Scenarios 1 and 2 represent logical and conservative actions to utilize technology in a way that improves education in the future. Each scenario represents incremental change that may be resisted by some, but will be, in general, supported by many as a means to plan for the future by adopting emerging technology tools. There is little risk for an educational leader to adopt technology addressing incremental change because the actions appear logical and obvious. The seductive nature of incremental change is that it appears we are preparing for a future that looks similar to the world we know today. Readers are encouraged to expand on any of the trends listed in Tables 1 and 2, or identify a trend not listed, to create their own incremental change scenario that may describe the future of special education.

Convergence Change Scenarios

A more challenging task involving incremental change relates to the impact of the convergence of multiple trends. Whereas there can be an element of predictability in this process, the convergence of trends has the potential to significantly impact the daily operation of inclusive education. Consider the following scenarios that illustrate the process of combining trends in ways that are not initially obvious (or, perhaps not deemed desirable by the status quo) and simultaneously accelerate the need for change.

Scenario #3

Trend Teacher Shortages + Online Learning

The Future The pandemic accelerated a trend in educators retiring or leaving the classroom. Teacher shortages are now common in most communities beyond the historical shortages of special education teachers. Given a shortage of qualified teachers, schools could invest in new online learning systems that provide direct instruction for students with access to online tutors as needed thereby reducing the number of teachers needed.

Implications School districts have purchased many types of digital curricula products that feature content aligned with standards, pre- and post-test assessment, and guided instructional learning modules. The scale-up of online teaching in K-12 during the pandemic has created a new infrastructure that could be significantly expanded again as a response to the shortage of qualified teachers. While some may view a change of replacing teachers with online instruction as undesirable, it may be necessary to address the teacher shortage, and these changes could become more attractive if bundled with childcare, academic and social enrichment opportunities to address society's needs for safe places for children during the work day. Parents of children with special education needs are often concerned about whether or not this scenario will help or hinder their child's progress.

Scenario #4

Trend Mental Health + Apps

The Future Emerging evidence suggests that the need for mental health services has increased exponentially during the pandemic. As a result, schools are likely to expand their implementation of social emotional learning (SEL) curricula and technology tools like apps. Well-designed mental health apps could provide early warn-

ing indicators to professionals to ensure that students receive the support services they need.

Implications   Schools will be expected to expand mental health services to students and expand SEL curricula to focus on prevention. UDL principles could be helpful in the design of app-based services with students receiving digital passes to in-school mental health services. Daily mental health check-ins could become a routine part of homeroom. Expanding mental health services for all students could be beneficial to many students with disabilities. Consideration will need to be made concerning the accessibility of apps.

The pandemic revealed that innovation can scale at a significant speed. And yet, as we seek to transition from life in a pandemic to living with viruses as part of an endemic, many experts believe that online learning will continue to be used widely. Many communities are now engaged in lively debates about what it means to return to "normal" or what a "new normal" should look like. For example, consider how some school districts have discontinued the concept of a snow day by simply declaring that a given day with excessive snow or ice will be a remote learning day rather than an in-person learning day. However, the key point here is that the convergence of trends is a complex matter, beyond the control of any one individual or organization. Now that almost all families have experienced online learning, there is considerable opinion and influence about what may come next. As a result, there is a need to examine each scenario and decide whether or not it is a viable description of the future and determine whether or not an organization should take action to move in that direction, or wait until more evidence is available to connect the dots.

Disruptive Change Scenarios

Individually, any one of the previous scenarios could affect the future of education (positively or negatively). However, when the trends and scenarios become bundled, they can produce powerful disruptive change scenarios. In this final section, I outline some disruptive change scenarios that I believe have the potential to emerge from the current chaos of post-pandemic education:

Scenario #5

Trend   Equity + Accountability + Learning Loss + Machine Learning + Learning Analytics

The Future   The pandemic revealed a number of structural inequities concerning learning and achievement for many groups of students, including students with disabilities. To address these shortcomings, new accountability efforts could be imple-

mented along with the use of machine learning and learning analytics to analyze student data in order to monitor student engagement and progress.

Implications The expanded use of digital curricula affords new opportunities for data collection, analysis, and reporting. Schools that are concerned about equity could use learning analytics to provide more personalized instruction and create data dashboards to provide public accountability about progress towards various goals. Because this scenario would probably place more emphasis on technology as a solution for closing the achievement gap, less emphasis may be given to teacher professional development. With the improvement of machine learning, the role of the teacher could be significantly altered and diminished as other adults are employed in schools to manage students.

Scenario #6

Trend Remote Learning + Space Utilization + Immersive Environments + Personalized Learning

The Future In the future, schooling could reflect the scheduling found in flexible office environments. That is, students and families would create a schedule that would involve some in-school time and some remote learning time reflective of personalized learning systems. Because not all students would be in a school building at the same time, space utilization will become a major opportunity for schools to create learning centers around the community, including under-utilized space in office buildings. This could mean that physical education is no longer conducted at school but at a local fitness center under the direction of a personalized trainer. Immersive environments could be created in schools or in office buildings to use the most advanced augmented and virtual reality tools to engage students in deep learning, accelerate learning outcomes, and decrease learning time. Such immersive learning centers could also be used by businesses to support advanced workforce development investments in their employees.

Implications The impact of COVID-19 has been disruptive to many societal institutions, including education. The pandemic exposed the critical role of schools not only in preparing the future workforce but also for providing children with safe environments while parents were working. Given the need for life-long education, disruptive applications of technology could provide critical flexibility for children and adults in personalizing learning processes and outcomes. Public schools that were built for the initiation of compulsory education in the 1800s are ripe for the re-imagination of the future of schooling where technology, personalization, and flexibility are characteristics of life in the twenty-first century.

Discussion

Educators are often so focused on their day-to-day work that there is little time for considering the emerging trends and issues happening around us. Trend analysis is a basic technique futurists use in order to develop scenarios that are helpful in planning for the future. Educational technology leaders and educators can use the information provided in Tables 1 and 2 to generate their own scenarios and evaluate the viability of such futures and the potential change on the horizon. While focusing on incremental change scenarios may allow some risk-averse leaders (Lovallo et al., 2020) to feel like they are helping an organization move into the future, risk-takers will aggressively focus on understanding trends that will lead to disruptive change. For those willing to take great risks, there is the potential for great reward.

The special educational needs of individuals with disabilities require considerable effort and technologies to assist them in maximizing their potential. However, there are many secondary benefits to society when some specialized technologies (i.e., screen magnification, text to speech, word prediction) are implemented as inclusive technologies, providing benefits for everyone (Edyburn, 2019). As a result, it is important to think about the needs of diverse individuals when planning for the future of education.

Conclusions

In conclusion, the author acknowledges that he does not have any special insight about the future of education. On the other hand, understanding how existing trends and issues can converge does provide a powerful tool for creating scenarios describing how the future might be different than today. Clearly, the pandemic significantly accelerated investments in technology, infrastructure, and innovation that set the stage for a future where education could look very different than current educational practice. Furthermore, trends in automation and machine learning have critical consequences for the employability of individuals with disabilities who currently work in jobs that are clearly targeted for elimination (Chai et al., 2016). As a result, it is essential that educators and leaders reflect on how the pandemic impacted education and begin re-imagining the future of schooling.

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