IDEA 50 Years Later: Technology and Teacher Preparation in Special Education

AUTHORS
Lisa A. Dieker
Sarah K. Howorth
Eleazar Vasquez III
Matthew T. Marino
James D. Basham

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ABSTRACT

This article reflects on the 50-year anniversary of the passage of the Individuals with Disabilities Education Act (IDEA) and the evolution of technology in special education. We examine how early assistive tools, digital and networked resources, immersive simulations, and emerging artificial intelligence (AI) have progressively influenced access, instructional design, and teacher preparation. Decades of empirical work document a shift from sporadic, tool-by-tool adoption toward purposeful integration within evidence-based instructional frameworks. Universal Design for Learning (UDL), data-based decision-making, and explicit instruction now anchor many technology-supported practices. Recent scholarship on digital competence, immersive practice environments, and accessible instructional materials reveals both momentum and missed opportunities. Preparation programs often rely on uneven faculty expertise, fragmented coursework, and weak alignment between methods, practicum experiences, and technology expectations. Teacher education must intertwine technology through program structures rather than confining it to isolated modules. Candidates need preparation to critically analyze tool quality, proactively design accessible instruction, and deploy technologies to facilitate measurable skill development rather than novelty-driven engagement. The article concludes by identifying research priorities and system-level redesign targets to position educators for classrooms shaped by AI, immersive learning systems, and rising accessibility standards.

KEYWORDS

Artificial intelligence, assistive technology, instruction, special education, universal design for learning

The Individuals with Disabilities Education Act (IDEA) reshaped the United States' educational landscape by securing a Free Appropriate Public Education (FAPE) in the least restrictive environment (LRE) and driving sustained improvements in services and outcomes for students with disabilities. Technology has extended IDEA's reach across five decades, moving from low-tech accommodations to sophisticated assistive and instructional systems, expanding access, supporting individualized instruction, and strengthening inclusive participation. This article traces technology's evolution in special education teacher preparation, synthesizes evidence on contemporary innovations, and identifies future directions as IDEA reaches its 50th anniversary. Each section of this article frames teacher preparation through guiding questions that connect historical developments to present program design and to ethically grounded technology use.

Reflective Questions

The following questions operationalize the relationship between policy, technology, and instructional practice in special education. Together, they prompt analysis of how IDEA's evolution has shaped access, innovation, and the use of data to ensure technology integration leads to meaningful and equitable student outcomes.

1. How has IDEA's policy trajectory enabled the adoption of assistive and instructional technologies?

TABLE 1: Chronological Timeline of Legislative Actions and OSEP Initiatives

Year	Legislative / Initiative	Impact on AT Inclusion
1975	Education for All Handicapped Children Act (P.L. 94-142)	Established IEPs and FAPE; set foundation for technology inclusion
1990	IDEA renamed; AT defined	Introduced AT devices and services
1997	IDEA Reauthorization (P.L. 105-17)	Required IEP teams to consider AT needs
2004	Individuals with Disabilities Education Improvement Act	Maintained AT consideration; allowed home use of AT devices
2006	Technology and Media Services for Individuals with Disabilities (OSEP)	Provided funding for accessible instructional materials and technology
2010	National Center on Accessible Educational Materials (AEM Center)	Supported states and districts in providing accessible digital materials
2012	Bookshare Expansion (OSEP Initiative)	Provided free accessible e-books for students with print disabilities
2014	Stepping Up Technology Implementation Grants (OSEP)	Funded projects to scale evidence-based technology practices in schools
2020	CIDDL (Center for Innovation in Digital Learning)	OSEP-funded center supporting teacher preparation in technology integration
2024	USDOE AT Guidance	Clarified obligations for AT funding, inclusion, and training

2. What policies had the greatest impact on equitable access?
3. What technological eras (e.g., early augmentative and alternative communication devices (AAC), mobile accessibility, AI-supported personalization) shifted classroom practice and student participation, and why?
4. What data practices (e.g., progress monitoring, MTSS) best ensure technology adoption improves individual student learning outcomes rather than just engagement?

Historical Foundations

Early assistive technologies in the 1970s and 1980s included low-tech tools (e.g., Braille, communication boards) and emerging electronic AAC prototypes. The Education for All Handicapped Children Act (Public Law 94-142) in 1975 and subsequent IDEA reauthorizations established rights, services, and funding that progressively broadened access, including early intervention (Part C of IDEA) and inclusive placement in the LRE. These policy milestones set conditions for the integration of computing, screen readers, and voice output devices in schools, leading to growth in student participation and outcomes across decades. Table 1 summarizes key statutory milestones and selected Office of Special Education Programs (OSEP) investments that shaped expectations for technology consideration, provision, and training within Individualized Education Programs (IEPs) over the past 50 years.

Research on teacher preparation began to converge on a consistent conclusion: technology improves learning only when educators align tools with instructional design, accessibility expectations, and UDL principles. Edyburn (2021) emphasized structured instructional decision-making and continuous evaluation as prerequisites for meaningful benefit. Woodward and Rieth (1997) showed technology-supported gains when teachers embedded tools within explicit, evidence-based instruction rather than as an add-on. UDL scholarship similarly centered proactive design to reduce barriers and support learner variability (Meyer et al., 2014). Rose (2013) refined the core assertion through a design critique: instruction built for an "average" learner excludes most learners. Therefore, preparation programs must help future teachers identify technology that supports individual student progress and develop the skills to use data, design accessible instruction, and deliver evidence-based, specialized instruction.

Reflective Questions

The following questions operationalize programmatic expectations for preparing candidates to use technology within IDEA-aligned practice. Together, they prompt examination of how preparation programs build, reinforce, and assess competencies in accessible design, data-informed instruction, and meaningful technology-supported access across coursework and clinical experiences.

1. Where do candidates practice applying IDEA technology requirements within an IEP meeting?
2. What is your program's minimum competence for selecting and using accessible educational materials?

3. Where is the technology competence taught, rehearsed, and assessed across experiences?
4. How does your program ensure candidates understand the difference between technology access and technology-supported access with explicit teaching and progress monitoring?

With the emergence of technology came an equal emergence of new terms. Key terms aligned with this shift are provided. Assistive technology refers to any item, equipment, or product system used to increase, maintain, or improve the functional capabilities of individuals with disabilities, as defined in federal policy under the Individuals with Disabilities Education Act (IDEA, 2004). In contrast, instructional technology is conceptualized as the theory and practice of designing, developing, utilizing, managing, and evaluating processes and resources to support learning, emphasizing systematic instructional design rather than individualized access (Januszewski & Molenda, 2008). Distinguishing these constructs is important for teacher preparation, as assistive technology centers on access and participation for learners with disabilities, whereas instructional technology focuses more broadly on how educators design and deliver effective instruction. Similarly, digital literacy and digital competence represent related but distinct constructs. Digital literacy, originally articulated by Gilster (1997), emphasizes the ability to access, evaluate, and use information in digital environments. Digital competence extends beyond these foundational skills to include the confident, critical, and responsible use of digital technologies for learning, work, and participation in society, integrating knowledge, skills, and dispositions within complex, technology-rich contexts (Vuorikari et al., 2022).

As technology became increasingly embedded within special education classrooms and legislation, policy-driven access alone was no longer sufficient to ensure meaningful student learning outcomes. Instead, effective implementation required teachers to demonstrate specific professional competencies aligned with the Council for Exceptional Children (CEC, 2020) and Interstate Teacher Assessment and Support Consortium (InTASC) standards (2013), including the ability to select and implement evidence-based instructional strategies, use technology to support explicit skill instruction, and engage in ongoing data-based decision-making. These competencies emphasize teachers' responsibility to monitor progress, analyze instructional data, and adjust instruction to promote skill acquisition and generalization. As a result, scholars began focusing on how preparation programs build candidates' technological pedagogical knowledge and help them integrate technology into systematic, data-informed instruction rather than using it as an isolated accommodation.

Technology integration in special education teacher preparation has evolved since 1975 alongside broader technological, pedagogical, and policy shifts. Research in the 1980s and 1990s foregrounded computers as primary instructional tools, emphasizing computer-assisted instruction and technology's role in teaching, assessment, and administrative work. The literature also tracked a terminological transition from "handicapped" to "disability," mirroring shifting policy language and conceptual commitments (Woodward & Rieth, 1997). During this period, investigators focused on academic instruction and assessment applications, with comparatively limited attention to the design and evaluation of teacher preparation itself.

Researchers in the late 1990s and early 2000s broadened the technology landscape from discrete assistive devices to digital texts, interactive media, and networked learning resources. Internet diffusion shifted practice from standalone tools to connected ecosystems that scaled up curricular materials, professional learning, and family–school communication. Reviews of preparation for the digital era documented uneven candidate readiness and weak program coherence (Starkey, 2020). Systematic syntheses of teachers' digital competence similarly reported structural gaps in the integration of coursework and clinical experiences. Preparation programs increasingly adopted the technological pedagogical content knowledge (TPACK) as a framework for integrating technology within the curriculum (Mishra & Koehler, 2006), yet the field continued to debate core constructs and boundaries for "digital literacy," causing ambiguity in both research and program design (Voultsiou & Moussiades, 2025).

The OSEP launched Stepping Up Technology Implementation grants in 2012 to accelerate development and classroom uptake of evidence-based assistive, accessible, and instructional technologies. The grants aimed to close the research-to-practice gap by requiring iterative development cycles grounded in implementation science and by embedding collaboration with educators, families, and students. Project teams refined tools for accessibility, IDEA alignment, and feasibility across early childhood through K–12 settings. The program emphasized broad availability to support preparation efforts (Evmenova et al., 2024).

Stepping Up projects generated measurable national impact. The OSEP funded 50 projects across 12 cohorts by 2024, with implementation reaching more than 37 school districts and serving over 36,000 students, including more than 10,000 students with disabilities (Evmenova et al., 2024). The portfolio yielded widely used tools linked to

student performance, implementation fidelity, and access to high-quality technology. Many products remained free or low-cost, which supported sustainability and dissemination beyond the initial federal investment.

Recent Developments and Current Practices

The Stepping Up initiatives broadened access to evidence-based technologies; however, teacher preparation programs now function within an increasingly complex and rapidly evolving instructional technology landscape. Recent syntheses emphasize digital literacy, professional digital competence, and immersive technologies, including artificial intelligence (AI), virtual reality (VR), and large language models (LLMs), in preservice and in-service preparation (Voultsiou & Moussiades, 2025). Programs increasingly use VR, technology-mediated project-based learning, and online professional development to strengthen instructional practice and classroom management in special education contexts (Dieker et al., 2023). Persistent constraints continue to limit implementation, including inadequate access, time scarcity, and teacher dispositions toward technology use (Papavlasopoulou & Koutromanos, 2024).

Early decades after IDEA positioned technology in preparation programs as discrete tools, such as computer-assisted instruction and foundational assistive devices. These tools were often housed in standalone courses rather than being embedded across program sequences (Wallace & Georgina, 2014). Reviews of assistive technology adoption continued to document a mismatch between policy expectations and everyday practice, with professional knowledge and evidence bases advancing more slowly than innovation cycles (Özdamar & Odluyurt, 2025).

Online delivery altered service delivery pathways in K–12 special education, yet empirical guidance lagged behind adoption demands. In response, Vasquez and Straub (2012) called for stronger design and implementation guidance for online instruction. Howorth and colleagues (2024) identified barriers that impede effective integration of technology in online special education preparation and practice. An emerging theme in national standards (ISTE, n.d.) is that preparation programs require explicit competencies in accessibility auditing, online instructional design, and data-informed instructional decision-making. The ISTE standards are relevant to special education because they define essential competencies for using technology to support inclusive instruction, personalize learning, and ensure equitable access for diverse learners, including students with disabilities. Simulation and mixed-reality (MR) platforms also expanded opportunities for practice. Mixed-reality research in special education preparation demonstrated that candidates who practice key instructional moves, receive focused feedback, and refine decisions in controlled settings gain clear benefits (Dieker et al., 2008). Programs continue to use simulation to improve fidelity of practices while reducing risk during early clinical experiences (Dieker et al., 2023).

Preservice programs in the 2000s and 2010s often emphasized general educational technologies, interactive whiteboards, presentation tools, and video, rather than special education-specific design problems. Studies reported gains in candidate self-efficacy and improvements in learner engagement and achievement when candidates designed instruction deliberately around technology integration (Wallace & Georgina, 2014). Reviews of virtual technologies in field experiences also highlighted the benefits of case studies, videoconference supervision, and early VR applications that support practice-based learning and development.

Mobile computing produced a second inflection point by embedding accessibility features in ubiquitous consumer devices rather than specialized hardware. Built-in speech and communication support on tablets and phones increased participation across contexts, elevating the importance of teaching feature selection, routine building, and progress monitoring in preparation programs (Apple, n.d.). Meta-analytic evidence linked text-to-speech and related read-aloud tools to improved reading comprehension for learners with reading disabilities, with study design moderating observed effects (Wood et al., 2017). Mobile diffusion also intensified equity challenges involving connectivity, device management, and capacity for home use. For example, in an upper elementary classroom, a teacher might use a tablet's built-in text-to-speech feature during reading instruction so a student with autism and a learning disability can independently access grade-level text while the teacher monitors comprehension through weekly progress monitoring data and adjusts supports accordingly (Howorth & Raimondi, 2019).

Immersive approaches, including VR, AR, MR, extended reality (XR), simulation, and UDL-aligned design, now blend physical and virtual environments to broaden practice opportunities in preparation. Technology is also increasingly intertwined with systemic instructional frameworks, particularly Multi-Tiered System of Supports (MTSS) and UDL. Educators use digital assessment platforms and curriculum-based measurement software to collect performance data efficiently, visualize growth, and adjust instruction based on responsiveness to intervention, core features of MTSS models that emphasize continuous data use, instructional intensity, and movement across tiers based on demon-

strated skill acquisition.

Within MTSS, technology-supported progress monitoring strengthens measurement of foundational academic skills such as reading fluency, decoding, computation, and written expression. Studies report improved fidelity and efficiency for data-based decision-making when teachers use technology-enhanced progress monitoring rather than paper-based systems (Fuchs & Fuchs, 2007; Stecker, 2006). These tools also support instructional precision by enabling educators to identify skill deficits, evaluate intervention effects, and adjust dosage, prompting, and feedback, competencies emphasized in special education professional standards. For example, a teacher might use a digital progress monitoring platform embedded with an AI-driven agent that automatically analyzes weekly one-minute CBM reading probes, flags students whose growth trajectories fall below expected benchmarks, and generates instructional recommendations. The teacher then reviews the agent's suggestions, adjusts grouping, intensity, or scaffolds, and monitors whether subsequent data indicate improved responsiveness within the MTSS tiered framework.

The UDL framework expanded technology's role by prioritizing proactive design over retrofitted accommodation. Digital tools now support multiple means of representation, engagement, and expression while maintaining commitments to explicit instruction. Empirical work cautions, however, that technology aligned with UDL principles produces the strongest effects when it operates inside systematic, evidence-based instruction rather than serving as a substitute for explicit teaching (Rao et al., 2014). Preparation programs, therefore, need to teach technology as an instructional method component through the concept of design, not merely as an access or engagement enhancement (Basham & Lowrey, 2025).

Extending the principles of UDL, video games emerged as a technology that integrates multiple means of engagement, representation, and expression within interactive learning environments, offering new opportunities to individualize instruction and support learner variability. The emergence of video games as learning technologies also contributed to the changing landscape of instructional design and assessment. Empirical scholarship demonstrated that video games can function as rigorous, content-specific instructional tools for students with disabilities when grounded in disciplinary standards and evidence-based pedagogy. Early work conceptualizing video games within a Response to Intervention framework illustrated how embedded scaffolds, real-time progress monitoring, and adaptive feedback provide tiered academic supports in secondary classrooms serving students with learning disabilities (Marino et al., 2010). Subsequent classroom-based investigations revealed that game-enhanced units, aligned with UDL principles, improved understanding and engagement compared with traditional text-based materials, particularly for students with disabilities in inclusive settings (Marino et al., 2014). Analyses of whole-class math interventions for students with learning disabilities showed that structured, technology-supported learning paths can accelerate conceptual growth when instruction includes explicit modeling, guided practice, and formative assessment (Hunt et al., 2025). Collectively, this work shows that well-designed video games can strengthen content instruction by improving attention, reducing executive-function demands, and increasing opportunities for practice, underscoring the need for video games in teacher preparation.

AI-enabled tools emerged in the late 2010s through adaptive platforms, automated progress monitoring, and predictive analytics. AI represents a paradigm shift because it moves technology beyond static tools toward systems that can generate content, adapt instruction in real time, and augment teacher decision-making through continuous data analysis. AI systems began to provide instruction through real-time adjustment of difficulty, pacing, and feedback, yet they still require teacher expertise to interpret outputs, verify validity, and integrate technology-generated information into instructional planning. AI, therefore, increases, rather than reduces, the need for strong competencies in instructional analysis, data-based decision making, and evidence-based practice.

In 2020, OSEP funded the National Center for Innovation, Design, and Digital Learning (CIDDL) to provide research-informed technical assistance and professional learning to strengthen faculty capacity to integrate educational technology, assistive technology, and AI into special education preparation (Marino et al., 2025). In 2024 the U.S. Department of Justice published an accessibility policy to raise expectations for preparation by requiring educators to evaluate web-based and mobile tools against web content accessibility guidelines standards in public education systems. The Department of Justice accessibility rule extended IDEA's focus on access by requiring that all digital materials used in public education meet established accessibility standards, thereby increasing expectations for teacher preparation programs. Specifically, candidates must be prepared not only to select technologies but also to evaluate and implement digital tools that are legally compliant, accessible, and usable for students with disabilities across instructional contexts.

AI marks another pivot in the field by coupling personalization and automation with heightened demands for professional judgment. Special education technology scholarship frames AI as disruptive

yet potentially beneficial when educators supervise outputs, interrogate bias, and protect student privacy (Marino et al., 2023). Personalized learning research similarly positions educators as designers and monitors of learning rather than delegates of instructional responsibility to software (Basham et al., 2016a). Work on UDL alignment in online and blended materials also reinforced a parallel obligation to evaluate accessibility and learning supports systematically (Basham et al., 2016b). Meta-analytic evidence reports promising effects of AI-based interventions for students with disabilities, elevating evaluation competence as a preparation priority (Zhang et al., 2024).

Across the 2000s and into the AI era, the literature consistently attributes technology's impact to teacher decision-making rather than to tools alone. The evidence base also continues to flag preparation gaps, especially in candidates' ability to evaluate technologies, align them with MTSS and UDL, and use data to support skill acquisition and generalization. These findings call for competency-based, data-driven preparation aligned with CEC and InTASC standards.

Reflective Questions

The following questions operationalize the role of technology within IEP development and broader systems of teacher preparation. Together, they prompt an examination of how tools and national initiatives support the effective implementation, integration, and monitoring of technology in special education practice.

1. How does technology support the development, implementation, and monitoring of IEPs?
2. What role do national initiatives play in integrating technology preparation effectively?
3. What has changed?

Schools initially used computer-assisted instruction to deliver practice, immediate feedback, and error correction (Woodward & Rieth, 1997). Research syntheses reported that educators achieved stronger outcomes when they aligned technology with explicit instruction and progress monitoring; researchers reported null or mixed results when alignment was weak, teacher expertise was limited, or implementation fidelity was low (Seo & Bryant, 2009). Internet diffusion broadened access to digital curricula, improved communication, and strengthened interagency coordination, enabling faster sharing of practices and deeper family–school collaboration. At the same time, growing reliance on the Internet heightened challenges related to device access, broadband gaps, privacy risks, and accessibility across platforms (Woodward & Rieth, 1997).

Teacher preparation programs adopted video cases to strengthen systematic observation, instructional decision-making, and reflective practice. Video cases supported literacy-focused learning for preservice special educators; evidence also showed outcomes comparable to lecture under some conditions, which underscores the need for structured prompts, targeted feedback, and explicit links between video analysis and instructional enactment (Yadav et al., 2009). Professional development research reported benefits from systematic video analysis for improving instructional practice, while moderator patterns indicated variation tied to educator characteristics and preparation (Morin et al., 2019). Accessible text systems, including Bookshare, expanded access to grade-level materials through flexible formats, text-to-speech, and navigation supports, yet effective use required coordinated eligibility procedures, preparation, and planning to prevent "access without instruction" (Newton & Dell, 2009). COVID-19 disrupted service delivery and exposed vulnerabilities in remote instruction for children with disabilities. Schools expanded teletherapy, learning management systems, and home–school communication; many families nevertheless reported accommodation gaps, service interruptions, and intensified caregiving demands during remote learning (Averett, 2021).

Mobile devices shifted accessibility from specialized hardware to built-in features embedded in platforms, which reduced stigma and supported independence. Evidence links text-to-speech, speech-to-text, and self-monitoring applications to improved access and targeted academic or behavioral outcomes when educators pair these tools with explicit instruction, strategy coaching, and progress monitoring (Wood et al., 2017; Wills & Mason, 2014).

Reflective Questions

To strengthen preparation in assistive technology and accessibility, the following questions focus on how programs build candidates' capacity for systematic decision-making and critical evaluation. Together, they prompt examination of how candidates learn to select, apply, and assess digital tools for accessibility and effective instructional use.

1. How will candidates learn a consistent assistive technology decision process (e.g., SETT: student, environments, tasks, tools)?
2. How will candidates learn to audit whether a digital curriculum, LMS, or app meets accessibility expectations?

IMPLICATIONS FOR RESEARCH AND PRACTICE

Technology-Enhanced Coursework and Content Preparation

Recent scholarship documents a shift from isolated "technology courses" toward programmatic infused designs across curricula and intentionally

integrates TPACK. Multimedia interventions, including Content Acquisition Podcasts, video vignettes, and related modules, produce statistically significant improvements in preservice special educators' knowledge and skill for delivering reading instruction to learners with disabilities compared with lecture- and reading-based formats (Kennedy & Thomas, 2012, 2016). Programs that embed technology across course sequences also report sustained gains in candidates' perceived proficiency and enacted use of tools during student teaching (Wallace & Georgina, 2014).

Emerging work increasingly connects technology integration to UDL and inclusive design. A University of Maine case study, developed in partnership with the CIDDL Tech Alliance, identified 10 barriers that constrain effective integration (Howorth et al., 2024). These barriers included inadequate access and infrastructure, limited professional development, the absence of a shared program vision, and inconsistent UDL integration in course design, particularly among faculty outside special education.

Faculty reported strong overall digital literacy but limited expertise in using emerging technologies to support learners with disabilities through UDL-aligned design. They also described challenges supervising clinical experiences at a distance. These findings align with broader recommendations for educator preparation programs (EPPs). Programs should integrate technology across coursework rather than isolate it in a single class. Faculty should model technology-supported, UDL-aligned pedagogy. Programs should also provide repeated cycles of practice paired with reflection. Finally, programs should cultivate candidate self-efficacy alongside equity-centered stances (Howorth et al., 2024).

OSEP-funded centers can mitigate systemic barriers by providing research, technical assistance, and professional development aligned with UDL and accessibility expectations. CIDDL and the National Center on Accessible Digital Educational Materials & Instruction (NCADEMI) support programs with embedding accessibility across coursework and clinical practice, moving beyond general digital literacy toward the purposeful use of assistive technologies, immersive tools, and AI-supported personalization. OSEP also supports Bookshare, which expands access to accessible digital texts for students with print disabilities.

The NCADEMI offers guidance for adopting accessible formats and digital materials, strengthening compliance with accessibility standards, and supporting faculty course design. CIDDL strengthens educator capacity through research-based frameworks, professional learning, webinars, and communities of practice that connect faculty with emerging technologies and evidence-based integration strategies. These centers support system-level adoption aligned with accessibility and learning science rather than episodic implementation.

Technology-supported research in special education continues to widen across disability categories, settings, and instructional aims. Much of the evidence base still concentrates on elementary and resource-room contexts, with less sustained attention to life skills, employment preparation, and social development outcomes (Olakanmi et al., 2020). These gaps matter because they limit the field's ability to prepare educators to support postsecondary, functional, and social outcomes, potentially narrowing the long-term impact of technology integration on students' independence and quality of life. Participatory design research helps address these limitations by centering teacher involvement in tool development, thereby increasing ecological validity through co-design approaches grounded in classroom realities (Tuhkala, 2021).

RECOMMENDATIONS FOR FUTURE USE AND VALIDATION OF TECHNOLOGY

The following recommendations translate these findings into actionable steps that programs can implement to strengthen coherent, sustained technology integration across preparation experiences. Technology often enters preparation as a discrete innovation or stand-alone course, which contributes to uneven implementation even when studies document benefits under systematic conditions (Wallace & Georgina, 2014). Preparation programs can reduce "pilot-only" cycles by adopting continuous, theory-driven evaluation and by planning for long-term integration from initial adoption through sustained implementation.

Researcher evidence identifies several high-yield directions for strengthening technology-rich preparation. Multimedia instruction and content-specific modules consistently improve preservice knowledge and skill (Wallace & Georgina, 2014). Mixed-reality and XR simulations support complex practice opportunities (e.g., classroom management, family communication, and IEP meetings), especially when programs pair simulation with coaching and structured reflection (Budin, 2024; Dieker et al., 2023; Qualls et al., 2024). Programs are increasingly adopting technology-infused curricula that build TPACK and embed UDL across coursework, rather than simple integration in special education methods courses (Howorth et al., 2024; Wallace & Georgina, 2014). Programs also need to embed UDL and digital equity principles to ensure accessibility and reduce barriers across populations (Howorth et al., 2024).

A rapidly expanding body of literature positions AI as both promising and

TABLE 2: Summary Recommendations Table

Priority Area	Recommended Actions for Special Education Teacher Preparation	Citations
Program design & culture	Develop a shared vision for technology and UDL across the college; integrate throughout coursework rather than isolating it in single courses.	(Howorth et al., 2024; Marino et al., 2025; Zepp et al., 2024)
Practice-based learning	Expand validated multimedia modules and XR/mixed-reality simulations for high-leverage practices; pair with coaching and reflection.	(Budin, 2024; Wang & Li, 2024; Zepp et al., 2024; Qualls et al., 2024)
Assistive & inclusive tech	Systematically teach AT, digital tools, and UDL; ensure practice with diverse devices, software, and accessibility.	(Howorth et al., 2024; Kurt & Erden, 2023)
Faculty & PD	Provide digital and pedagogical PD; build networked, digital communities.	(Howorth et al., 2024)
Candidate perceptions & self-efficacy	Use surveys and reflection to monitor candidate technology beliefs, competencies, and self-efficacy.	(Vellonen et al., 2025; Kurt & Erden, 2023)
AI integration	Integrate AI literacy, ethics, and classroom applications	(CIDDL, 2024; Marino et al., 2023)

disruptive. AI tools increasingly shape instructional design, feedback processes, and material adaptation (Howorth et al., 2024). Generative AI can reduce educator workload and support access by assisting with tasks such as lesson planning, feedback generation, and differentiated materials (Goldman et al., 2024). Research with college students with disabilities further illustrates this potential, showing that AI can ease writing challenges and expand access to academic tasks (Zhao et al., 2025). Practice-oriented studies also describe early adopters integrating AI into preparation by aligning objectives, generating assignments and rubrics, designing cases, supporting IEP goal development, and facilitating chatbot-mediated reflection (Howorth et al., 2024).

At the same time, AI introduces significant risks and unresolved challenges. Effectiveness depends on verification routines, instructional coherence, and robust ethical safeguards (Goldman et al., 2024). Concerns related to accuracy, bias, privacy, cost, and academic integrity remain substantial (CIDDL, 2024a; Marino et al., 2023). Evidence on AI in teacher preparation remains early-stage, with limited intervention research and ongoing questions about how to prepare candidates for the ethical and responsible use of AI in AI-rich schools. Preparation programs, therefore, must balance innovation with safeguards while strengthening the evidence base for AI preparation (Marino et al., 2025). Three priorities can guide near-term work:

1. **Intentional integration with safeguards:** Use AI for design support, data-informed reflection, differentiated planning, and simulated practice while ensuring human oversight and attention to bias, privacy, and transparency (CIDDL, 2024b).
2. **Develop AI literacy as a core competence:** Teach candidates to prompt, critique, and adapt AI outputs for IEP development, progress monitoring, and UDL-aligned planning (McMahon & Firestone, 2024), and to use AI ethically and accessibly (CIDDL, 2024b). For example, candidates might analyze an AI-generated IEP goal, identify inaccuracies or biases, and revise the goal using progress-monitoring data and evidence-based practices.
3. **Build an evidence base:** Prioritize rigorous interventions that examine AI's impact on preservice teacher learning and student outcomes, using mixed methods and pedagogical documentation beyond standardized tests (Marino et al., 2023).

Table 2 synthesizes recommendations for strengthening technology integration in special education teacher preparation. The priorities emphasize coherent program design, authentic practice, sustained faculty learning, and deliberate support for competence and confidence. Taken together, these findings suggest that effective program design requires intentional, sustained integration of technology across coursework and clinical experiences to ensure candidates develop applied, transferable competencies rather than isolated skills.

This article contributes a coherent framework for integrating technology across policy, practice, and preparation, emphasizing the need for systematic, data-informed, and equity-centered approaches to preparing educators in an evolving technological landscape. Fifty years after IDEA, technology has moved from a peripheral tool to a central, though unevenly applied, element of special education teacher preparation. The field now needs intentional scaling of evidence-based multimedia instruction,

ABOUT THE AUTHORS

Lisa A. Dieker, Ph.D.

Dr. Dieker is the Williamson Family Distinguished Professor of Special Education in the School of Education and Human Sciences at the University of Kansas and director of the Flexible Learning Through Innovations in Technology and Education Center. Her research focuses on teacher education, special education, inclusive STEM instruction, and the use of emerging technologies to improve teacher performance and student learning.

Sarah K. Howorth, Ph.D.

Dr. Howorth is an Associate Professor of Special Education at the University of Maine's College of Education and Human Development. She leads the PEERS® Lab at UMaine and is an associated faculty member of the Center for Community Inclusion and Disability Studies (CCIDS), Maine's only University Center for Excellence in Developmental Disabilities (UCED).

Eleazar Vasquez III, Ph.D.

Dr. Vasquez is a professor of special education at the University of Kansas. His research explores how technology can enhance academic and behavioral outcomes for students with disabilities, particularly within rural and underserved communities, while his leadership work includes AI policy, technology modernization, workforce development, and interdisciplinary collaboration.

Matthew T. Marino, Ph.D.

Dr. Marino is a Pegasus Professor of Exceptional Student Education and Director of the Toni Jennings Exceptional Education Institute at the University of Central Florida. His research focuses on Universal Design for Learning, AI-enhanced learning, executive functioning, and the design and implementation of technology-based STEM interventions for individuals with disabilities.

James D. Basham, Ph.D.

Dr. Basham is a professor in the Department of Special Education at the University of Kansas. His research focuses on Universal Design for Learning, artificial intelligence, STEM education, learner-centered design, innovation, and the development of equitable and meaningful future-ready learning environments.

XR-supported practice, program-wide integration of UDL, and a stronger empirical base for AI-supported preparation. Technology use has progressed from basic computing to immersive, practice-centered, and participatory design approaches. Yet gaps remain in digital competence, coherent integration across coursework and clinical experiences, and evidence that extends beyond narrow academic outcomes. Preparation programs need to pursue ongoing innovation paired with targeted evaluation to realize technology's full instructional potential. To close, consider two questions. 1) Which emerging technology will redefine special education preparation over the next 50 years? 2) How can programs stay ahead of technological change to best support students with disabilities? Addressing these questions requires not only anticipating innovation, but also building systems that prioritize adaptability, critical evaluation, and sustained alignment with evidence-based practice. Ultimately, the future of teacher preparation will depend on how effectively programs translate technological advances into meaningful learning opportunities.

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