

Empowering Learning Through Innovation: Schema-Based Instruction, Video Modeling, and Virtual Tools in Special Education

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Abstract:

This paper presents a systematic review of contemporary research and policy developments in special education in the United States, with a particular focus on instructional strategies and inclusion. It examines the application of evidence-based practices such as schema-based instruction, video modeling, and the use of virtual manipulatives to support students with learning disabilities. The review also addresses methodological considerations, including the growing use of single-subject design and nonoverlap effect size techniques to assess intervention efficacy. Special attention is given to the educational experiences of Deaf and Hard of Hearing (DHH) students, highlighting persistent challenges related to digital accessibility, language equity, and vocational inclusion. Drawing from a comprehensive range of scholarly sources and official policy documents, the study underscores the transformative impact of educational technologies and evolving legislative frameworks on inclusive education. While notable progress has been made in integrating technological innovations into instructional settings, systemic barriers—particularly for DHH learners—continue to limit full participation. The paper concludes by advocating for large-scale implementation of validated interventions, enhanced educator training, and coherent policy reforms to promote equity and inclusion across all levels of education.

Keywords: special education, learning disabilities, Deaf and Hard of Hearing (DHH), inclusive education

Introduction:

Special education in the United States has undergone profound evolution over the past few decades, driven by federal mandates, educational reform efforts, and shifting paradigms surrounding disability and inclusion. Landmark legislation such as the Individuals with Disabilities Education Act (IDEA) has established the legal foundation for equitable education, mandating Free Appropriate Public Education (FAPE) in the least restrictive environment.

These legal advances have encouraged the implementation of inclusive educational practices and data-driven interventions. Nevertheless, despite strong policy frameworks, the practical realization of inclusive and individualized instruction continues to encounter challenges in consistency, implementation fidelity, and accessibility across school systems.

Research has played a vital role in advancing special education by identifying effective instructional strategies for students with disabilities, particularly those with learning disabilities. Schema-based instruction, for example, has shown promise in helping students solve complex mathematical problems by offering structured approaches to problem-solving (Özkubat, Karabulut, & Akçayır, 2020). Similarly, video modeling has been shown to support students with learning disabilities in both algebra and geometry through engaging and replicable demonstrations of problem-solving processes (Satsangi, Billman, Raines, & Macedonia, 2020; Satsangi, Hammer, & Bouck, 2020). Furthermore, the use of virtual manipulatives, as studied by Shin et al. (2017), has helped students better visualize mathematical concepts, while computer-assisted instruction has also proven effective in improving students' mathematical performance (Terzioğlu, Curaoglu, & Yıkmiş, 2019).

Technology has also enabled the expansion of online learning modalities tailored to students with disabilities. Straub and Vasquez (2015) investigated synchronous online writing instruction and found it beneficial in enhancing writing skills for students with learning disabilities. Young et al. (2019) further demonstrated that text-to-speech technology significantly improved reading comprehension for secondary students with reading difficulties. These findings underscore the growing importance of integrating digital tools into special education classrooms to enhance learning outcomes and provide greater accessibility and autonomy to students with diverse needs.

A critical component of special education research is the use of single-case experimental designs (SCEDs) to evaluate intervention effectiveness. Foundational studies by Scruggs, Mastropieri, and Casto (1987) and updates by Scruggs and Mastropieri (2013) provided methodological guidance on summarizing single-subject research. Rogers and Graham's (2008) meta-analysis of writing interventions using SCEDs highlighted their practical utility in special education settings. Recent studies have focused on refining effect size calculations for SCEDs using non-overlap methods, as explored by Parker, Vannest, and Davis (2011), Rakap, Yucesoy-Ozkan, and Kalkan (2020), and Şen and Şen (2019), helping to ensure greater reliability and interpretability of intervention results.

Despite these advancements, persistent challenges remain in ensuring equitable, effective, and individualized education for all students with disabilities. For instance, students with autism spectrum disorder continue to need targeted interventions, such as safety skill instruction reviewed by Tekin-Iftar et al. (2021).

While the tools and strategies for instruction are becoming more sophisticated, the field still struggles with issues of scalability, training, and consistency in implementation. The future of special education lies in expanding these research-driven practices into broader educational policies and ensuring that innovations are both inclusive and sustainably embedded in everyday teaching practices.

Literature Review:

The global movement toward inclusive education has significantly reshaped the frameworks and practices that guide the education of students with disabilities. Influenced by international agreements such as the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), many countries have intensified efforts to promote equity in education through legal mandates, vocational programs, and technological innovations (Quinlivan, 2012; Nizar, 2011). Within this context, Greece and other nations have implemented multiple policy interventions and digital strategies aimed at enhancing access, inclusion, and lifelong learning for persons with disabilities.

A substantial body of literature emphasizes the importance of legal and policy frameworks in supporting inclusive education. The Greek government's initiatives, including the Ministerial Circular DIADP/F.B.3./3569/10-02-2009, have institutionalized workplace accommodations for public employees with disabilities or those with disabled children.

Moreover, Presidential Decree 85/2022 outlines qualifications for public appointments, reinforcing equitable representation. National strategies, such as Greece's National Strategy for the Rights of Persons with Disabilities 2024–2030, reflect a holistic and rights-based approach to disability inclusion in both education and employment (Ministry of Labor and Social Security, 2024). These policies align with international calls for inclusive human rights

as detailed by O'Mahony and Quinlivan (2020), who underscore the obligation of states to enact systemic reforms to uphold the dignity and rights of persons with disabilities.

Educational technologies have become central to inclusive education, especially in contexts shaped by crises such as the COVID-19 pandemic. Peruzzo and Allan (2022) argued that digital inclusion must transcend basic access and be grounded in conviviality and interactivity. Greek initiatives, including the deployment of educational television and the provision of Greek Sign Language (GSL) interpreters for televised lessons (Ministerial Circular 43569/G.D.4/6-4-2020; Ministerial Decision 43037/G.D.4/3-4-2020), highlight early steps toward this reconceptualization. The Pedagogical Institute (2008) further emphasized the need for teacher training in using accessible software, recognizing that technology alone cannot resolve exclusion without proper pedagogical integration.

In exploring the experiences of deaf and hard-of-hearing (D/HH) learners, several studies illuminate systemic challenges and potential interventions. Rohatyn-Martin (2017) detailed the social and instructional barriers D/HH students face in mainstream classrooms, while O'Neill and Wilks (2021) assessed the impact of the British Sign Language (Scotland) Act 2015, emphasizing the need for legislative frameworks that guarantee language rights.

Polanco Jr and Liu (2023) noted an inclusion gap in the design of digital assessments, particularly for D/HH middle school students in the United States. Complementarily, Portugal et al. (2023) demonstrated the value of bilingual digital narratives in fostering inclusion for deaf children, and Prietch and colleagues (2015a, 2015b) proposed user-centered digital tools co-designed with the deaf community. Together, these studies affirm Napier and Leeson's (2016) position that sign language inclusion must be active and systematic, not symbolic.

Vocational training and employment access remain pivotal to inclusive education outcomes. Vocational pathways, when supported by targeted policies and community collaboration, can enhance the transition from education to employment for students with disabilities. Musa (2022), in a study on Ghana's Ashanti School for the Deaf, found that structured vocational programs improve employment outcomes. Similarly, the Municipal Employment Service (2010, 2016) in Athens established operating frameworks for vocational training schools tailored to individuals with disabilities, laying the groundwork for professional inclusion. In the U.S., Palmer et al. (2020) highlighted disparities in vocational rehabilitation access among deaf populations, and Punch (2016) reported stressors and unmet accommodations in the workplace for D/HH adults. Nota et al. (2014) revealed that employer attitudes remain a persistent barrier, reinforcing the need for more inclusive workplace cultures.

Career guidance, as a bridge between education and employment, has also drawn scholarly attention. Romero-Rodríguez et al. (2022) identified best practices in integrated career guidance in Spain, emphasizing the value of individualized planning. OECD (2020) supported this view, advocating for early, tailored interventions that connect learning with labor market realities. However, Quirke and Mc Guckin (2024) argued that traditional guidance practices often silence D/HH individuals, highlighting a disconnect between inclusive theory and exclusionary praxis. Punch, Hyde, and Creed (2004) similarly documented challenges in the school-to-work transition for hard-of-hearing adolescents, reinforcing the importance of meaningful support structures.

The literature reviewed here collectively demonstrates that while policy, technology, and vocational structures have advanced, there remains a pressing need for critical, intersectional, and community-driven approaches to inclusive education. Inclusion is not only about access—it is about agency, participation, and the systemic transformation of environments that have historically marginalized students with disabilities. Future research should continue to explore how legal mandates, digital innovations, and educational practices can intersect to create equitable, empowering systems for all learners.

Methodology:

This study employed a systematic review methodology to synthesize existing research on special education practices, with particular emphasis on instructional interventions, assessment techniques, and inclusive education outcomes. The review focused on peer-reviewed journal articles, policy documents, and doctoral dissertations published between

2004 and 2023. The temporal scope was selected to capture both foundational and contemporary developments in the field, particularly in response to evolving educational technologies and federal mandates in the United States.

Inclusion criteria required that sources be directly relevant to special education in the U.S. context, with a focus on students with learning disabilities, autism spectrum disorder, and deaf or hard-of-hearing (D/HH) populations. Priority was given to studies that employed rigorous methodologies, such as single-case experimental designs (SCEDs), as well as those that evaluated the impact of evidence-based interventions, including schema-based instruction, video modeling, virtual manipulatives, text-to-speech tools, and synchronous online instruction. Policy documents were selected based on their relevance to legal frameworks, teacher training, and accessibility standards in both educational and vocational contexts.

Data sources included academic databases such as ERIC, JSTOR, ScienceDirect, and Google Scholar, as well as institutional repositories and government archives. Each document was reviewed systematically and coded based on research focus, target population, methodology, and key findings. Thematic analysis was then applied to identify common patterns, emerging trends, and critical gaps in the literature. In doing so, the review sought to understand the interplay between instructional strategies, technological tools, and policy support in promoting equitable learning outcomes for students with disabilities.

This methodological approach ensured a comprehensive and critical understanding of the current landscape in U.S. special education, while highlighting areas for further inquiry and practical implementation.

Findings and Discussion:

Instructional Strategies for Students with Learning Disabilities:

Recent developments in instructional strategies have shown significant promise in supporting students with learning disabilities (LDs), particularly in mathematics and literacy instruction. Özkubat, Karabulut, and Akçayır (2020) emphasized the benefits of schema-based instruction, a method that teaches students to use structured frameworks for problem-solving. Their findings revealed that students with LDs showed improved comprehension and retention in mathematical problem-solving tasks, indicating that organizing information schematically enhances working memory and strategic thinking.

Similarly, Satsangi and colleagues have made notable contributions to the use of video modeling in mathematics instruction. In their 2020 studies, Satsangi, Billman, Raines, and Macedonia demonstrated the effectiveness of video modeling in teaching algebra, while Satsangi, Hammer, and Bouck (2020) applied the same approach to geometry word problems. Both studies found that video modeling not only improved student comprehension but also reduced cognitive overload by providing step-by-step visual instruction. These interventions promote greater learner independence and reduce the need for continuous adult prompting.

Shin et al. (2017) extended this work by exploring the benefits of virtual manipulatives in helping students understand abstract mathematical concepts. Their research indicated that digital tools provided tactile and visual support that traditional methods lacked. Terzioğlu, Curaoglu, and Yıkmiş (2019) confirmed these findings, showing that computer-assisted instruction significantly improved the mathematical performance of students with special learning difficulties.

In the area of literacy instruction, Straub and Vasquez (2015) examined the effects of synchronous online writing instruction and found that it enhanced student engagement and writing outcomes. Similarly, Young et al. (2019) investigated the use of text-to-speech technologies and found a positive impact on reading comprehension and motivation among secondary students with LDs.

To measure the impact of these interventions, researchers have used a variety of effect size metrics within single-case experimental designs. Parker, Vannest, and Davis (2011), as well as Rakap, Yucesoy-Ozkan, and Kalkan (2020), explored nonoverlap techniques such as PND, PEM, and Tau-U, which have become standard practices in determining intervention effectiveness. Scruggs, Mastropieri, and Castro (1987) contributed significantly to this methodological discussion, providing validation for these statistical techniques. Their subsequent work with Casto (1987) and Scruggs

& Mastropieri (2013) further examined the evolution and limitations of these measures, advocating for more nuanced interpretations of data in single-subject research.

Rogers and Graham's (2008) meta-analysis on writing interventions underscored the overall effectiveness of single-subject designs in special education research, confirming that individualized interventions can yield measurable improvements in student performance. Sen and Sen (2019) also examined the application of effect size calculations, reinforcing the value of non-regression-based methods in understanding instructional efficacy.

These instructional advancements are complemented by broader educational and policy initiatives aimed at enhancing inclusion. For example, Ministerial Circular 43569/G.D.4/6-4-2020 and Ministerial Decision 43037/G.D.4/3-4-2020 promoted the integration of Educational Television and sign language interpretation into remote instruction in Greece, a model which aligns with the Universal Design for Learning (UDL) principles. These efforts were reinforced by the National Strategy for the Rights of Persons with Disabilities (2024-2030), which underscores inclusive educational environments as a national priority.

Policy frameworks like the Ministerial Circular DIADP/F.B.3./3569/10-02-2009 also reflect institutional support for inclusive work arrangements for people with disabilities. Vocational training initiatives by the Municipal Employment Service (2010; 2016) and studies such as Musa (2022) and Romero-Rodríguez et al. (2022) have shown that targeted education and training programs significantly enhance employment opportunities for students with disabilities.

Meanwhile, the role of technology in promoting inclusion continues to expand. Studies by Peruzzo and Allan (2022), Polanco Jr. and Liu (2023), and Portugal et al. (2023) advocate for digitally inclusive design that considers the unique needs of deaf and hard-of-hearing (D/HH) students. Napier and Leeson (2016), O'Neill and Wilks (2021), and Punch (2016) provide critical insight into how legislative measures and educational practices intersect to support D/HH learners, while Prietch and colleagues (2015a; 2015b) stress the importance of accessible digital interfaces.

These findings suggest that instructional strategies for students with LDs must be embedded within broader, inclusive educational ecosystems supported by research-based interventions, robust effect size evaluation, and responsive policy frameworks. The interplay between pedagogy, technology, and policy creates a dynamic structure through which students with LDs can achieve meaningful academic and vocational success.

Evaluating Effectiveness through Single-Case Design

Single-case experimental design (SCED) continues to be a cornerstone methodology in special education research, offering rigorous and individualized evaluations of intervention effectiveness. This approach is particularly relevant for learners with disabilities, whose unique profiles often require tailored strategies that may not be captured through large-group studies. Foundational work by Scruggs, Mastropieri, and Casto (1987) laid the groundwork for synthesizing single-subject research. They emphasized the importance of quantifying intervention outcomes through consistent methodological criteria, which have since shaped numerous empirical investigations. Scruggs and Mastropieri (2013) further contributed to this body of knowledge by assessing trends in the use of percentage of non-overlapping data (PND) and other visual-analytic techniques over time, acknowledging both the strengths and limitations of such methods in summarizing intervention effectiveness.

A critical advancement in SCED has been the refinement of effect size calculations. Effect sizes enable researchers to make sense of intervention impacts beyond visual analysis, particularly when comparing results across studies. Parker, Vannest, and Davis (2011) conducted a comprehensive review of nine non-overlap techniques, including the Nonoverlap of All Pairs (NAP) and the Tau-U statistic, which improve upon earlier models by incorporating baseline trends and reducing biases. Similarly, Rakap, Yucesoy-Ozkan, and Kalkan (2020) examined these nonoverlap methods in greater depth, emphasizing their utility in evaluating the magnitude of change in single-case studies. Şen and Şen (2019) also explored non-regression-based techniques for calculating effect sizes, further confirming that robust and statistically interpretable outcomes can be derived even from studies with limited sample sizes—an inherent feature of SCEDs.

Numerous empirical studies utilizing SCED methodologies have demonstrated the effectiveness of specialized instructional strategies for students with learning disabilities. For instance, Rogers and Graham (2008) conducted a meta-analysis of single-subject writing intervention studies and found consistent, statistically significant improvements in students' writing quality, productivity, and motivation. Their research confirmed that interventions such as self-regulated strategy development (SRSD) and digital writing supports could yield substantial educational gains, reinforcing the value of SCED in determining what works for struggling writers.

Video modeling has also emerged as a prominent SCED-supported strategy, particularly in mathematics instruction. Satsangi, Billman, Raines, and Macedonia (2020) investigated the use of video modeling for teaching algebra to students with learning disabilities and reported notable improvements in conceptual understanding and problem-solving efficiency. In a follow-up study, Satsangi, Hammer, and Bouck (2020) applied similar techniques to geometry word problems and found that video-based instruction helped students visualize and internalize mathematical structures more effectively than traditional approaches. These studies underscore the versatility of SCED in evaluating complex cognitive interventions.

Beyond video modeling, computer-assisted and virtual tools have proven effective in SCED-based evaluations. Shin et al. (2017) reported that virtual manipulatives improved mathematics learning outcomes for students with learning disabilities, particularly in making abstract concepts more tangible. Similarly, Terzioğlu, Curaoğlu, and Yıkmış (2019) conducted a descriptive analysis of studies using computer-assisted instruction, affirming its role in developing mathematical skills among students with special learning difficulties. These technological interventions align with broader educational shifts toward digital integration and further validate the capacity of SCED to evaluate emerging instructional modalities.

Text-to-speech (TTS) technology has also been scrutinized using SCED frameworks. Young, Courtad, Douglas, and Chung (2019) evaluated the impact of TTS on reading comprehension for secondary students with learning disabilities. Their findings revealed that TTS significantly enhanced reading accuracy and engagement, especially for students who struggle with decoding. Such insights are crucial, given the increasing reliance on digital texts in modern classrooms.

Furthermore, schema-based instruction has gained traction as a robust instructional model, particularly for mathematics problem-solving. Özkubat, Karabulut, and Akçayır (2020) highlighted that schema-based instruction enabled students with learning disabilities to better organize and apply problem-solving strategies. Their SCED-informed evaluation confirmed that the systematic use of schemas not only improved performance during intervention phases but also resulted in sustained retention of skills, affirming the long-term benefits of such methods.

Importantly, SCED is also being used to evaluate broader areas of instruction and safety interventions. Tekin-Iftar et al. (2021), in a systematic review of safety skill interventions for individuals with autism spectrum disorder, demonstrated how single-case designs provide precise measurements of learning and generalization—key aspects when addressing functional life skills.

Single-case experimental designs offer a powerful and flexible framework for evaluating a wide range of interventions in special education. From writing and mathematics instruction to technology-assisted learning and safety skill development, SCED provides granular, individualized insights that are essential for crafting effective, evidence-based practices. The continued refinement of effect size metrics and analytic techniques strengthens the credibility of SCED findings, ensuring they remain vital to both researchers and practitioners dedicated to enhancing outcomes for students with disabilities.

Digital Tools and Online Learning for Students with Disabilities

The integration of digital tools and online platforms in education has significantly advanced the inclusion of students with disabilities, particularly following the global disruption caused by the COVID-19 pandemic. With the transition to remote learning, technology has not only bridged educational gaps but has also redefined the ways in which individualized instruction can be delivered. For students with disabilities—especially those with learning difficulties

or sensory impairments—these tools have proven to be more than mere supplements; they are essential educational resources.

Straub and Vasquez (2015) demonstrated the efficacy of synchronous online writing instruction for students with learning disabilities, emphasizing its role in maintaining engagement and fostering academic growth in virtual environments. Their findings highlighted that structured and interactive online teaching methods can replicate, and in some cases surpass, the outcomes of face-to-face instruction for students who require specialized support. Supporting this, Young et al. (2019) found that the use of text-to-speech (TTS) technologies significantly improved reading comprehension, fluency, and motivation among secondary students with learning disabilities. TTS tools allowed students to access grade-level content independently, reducing reliance on human readers and enabling greater academic autonomy.

Digital inclusion, however, must go beyond mere access to technology—it must also address design equity. Peruzzo and Allan (2022) argue for the use of “convivial technologies,” particularly in post-pandemic education. Their concept calls for rethinking inclusive (digital) education through the lens of participatory and user-centered design. They stress that platforms must be adapted to students’ diverse needs rather than expecting students to adapt to rigid, standardized systems. This is especially relevant for students with sensory impairments, such as those who are deaf or hard of hearing (D/HH).

Polanco Jr. and Liu (2023) revealed a significant inclusion gap in digital assessment tools used for middle school-aged D/HH students. Their study underscored that current assessment platforms often fail to consider the linguistic and cultural needs of these learners, thereby hindering accurate performance evaluations and limiting their educational equity. Addressing this concern, Portugal et al. (2023) emphasized the potential of bilingual digital narratives designed for deaf children. Their research advocated for software that incorporates both sign language and written language to enhance comprehension and storytelling. Likewise, Prietch and colleagues (2015a, 2015b) investigated how deaf students engage with educational technologies. Their work revealed that inclusive design—incorporating customizable interfaces, visual cues, and user feedback—was critical for promoting accessibility and fostering meaningful learning experiences in inclusive classrooms.

Mathematics education has also benefitted from digital interventions. Shin et al. (2017) reported that virtual manipulatives are effective in helping students with learning disabilities understand abstract math concepts. These tools provide dynamic visual and interactive representations that facilitate deeper cognitive engagement with numbers and operations. Terzioğlu, Curaoglu, and Yikmiş (2019) supported these findings through a descriptive analysis of computer-assisted instruction in mathematics. Their research showed significant gains in the computational and problem-solving skills of students with special learning difficulties when digital resources were employed strategically.

Further research on video modeling has also proven promising. Satsangi et al. (2020a, 2020b) explored how video modeling supported students with learning disabilities in algebra and geometry instruction. Their findings demonstrated that visually rich and step-by-step modeling significantly improved conceptual understanding and procedural accuracy. These interventions are especially well-suited for SCED (single-case experimental design) evaluations due to their ability to capture individual progress and provide visual evidence of change.

The application of SCED in assessing digital interventions has been validated by researchers such as Scruggs, Mastropieri, and Casto (1987), and later Scruggs and Mastropieri (2013), who laid the methodological foundation for quantitative synthesis of single-subject studies. Subsequent scholars, including Parker, Vannest, and Davis (2011) and Rakap et al. (2020), refined the measurement of effect sizes in SCED using non-overlap techniques, making it easier to interpret the success of interventions like TTS and video modeling. Şen and Şen (2019) further confirmed that non-regression-based effect size methods are reliable for evaluating digital educational tools in SCED contexts, especially when tracking changes in small, individualized samples.

One example of such application is schema-based instruction for problem-solving. Özkubat, Karabulut, and Akçayır (2020) explored how digital schema-based learning strategies helped students with learning disabilities solve

mathematics word problems. The instructional design, delivered via digital means, provided structure and repeatable cognitive routines that allowed students to better understand and generalize problem-solving processes.

Beyond classroom instruction, national and institutional efforts have also emphasized the importance of equitable digital education. Ministerial Circular 43569/G.D.4/6-4-2020 from the Greek Ministry of Education encouraged the use of educational television and digital platforms for students with disabilities during the pandemic. Furthermore, the 2024–2030 National Strategy for the Rights of Persons with Disabilities in Greece emphasized digital accessibility, participation in lifelong learning, and tailored support in remote learning environments (Ministry of Labor and Social Security, 2024). Such policies reinforce the necessity of not just integrating digital tools, but of doing so in ways that prioritize inclusivity and accessibility from the outset.

Digital and online learning tools have played a transformative role in special education, enabling individualized and inclusive instruction for students with diverse needs. From synchronous online teaching and TTS to video modeling and accessible digital design for deaf students, the spectrum of technologies is broad and promising. However, true inclusion demands ongoing attention to user-centered design, cultural and linguistic appropriateness, and rigorous evaluation through methodologies like SCED. With careful implementation and policy support, digital education can continue to expand opportunities for students with disabilities—making learning not only accessible but genuinely empowering.

Policy, Rights, and Vocational Inclusion

Over the past two decades, both international and national policy frameworks have increasingly recognized the rights of persons with disabilities, placing a strong emphasis on inclusive education and vocational integration. The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) serves as a cornerstone of this global agenda, mandating equal access to education, work, and societal participation (Quinlivan, 2012; Nizar, 2011). National legislation such as the United States' Individuals with Disabilities Education Act (IDEA) similarly upholds the right to inclusive education, promoting individualized support and transition services that prepare students for independent adult life.

However, while these policies signal progress, significant implementation gaps remain—particularly in vocational preparation and employment inclusion for persons with disabilities, such as those who are Deaf or Hard of Hearing (D/HH). Palmer et al. (2020), in their review of vocational rehabilitation services for deaf individuals in the U.S., found disparities in who receives services and how effective these services are in supporting successful employment outcomes. The researchers highlighted systemic barriers including limited accessibility, communication mismatches, and inadequate counselor training in deaf culture and sign language.

The transition from school to work presents unique challenges for D/HH youth. Punch, Hyde, and Creed (2004) identified systemic obstacles such as a lack of appropriate accommodations, limited career guidance, and insufficient workplace readiness programs. In a follow-up study, Punch (2016) documented the lived experiences of deaf adults, revealing persistent workplace discrimination, stress, and a shortage of inclusive employment opportunities despite legal protections. These findings suggest that while legislative progress has been made, real-world implementation continues to lag, leaving many D/HH individuals marginalized within the labor market.

O'Mahony and Quinlivan (2020) contextualize these challenges within broader international human rights discourse, arguing that disability rights must be seen not just as legal mandates but as essential components of social justice. Their analysis underscores the need for policy coherence—linking education, labor, and social welfare systems to create an integrated support network for people with disabilities.

Beyond rights-based frameworks, employer attitudes also shape the success of vocational inclusion. Nota et al. (2014) examined perceptions among employers and found that while many expressed support for inclusive hiring in principle, concerns about productivity, cost, and communication barriers often led to hesitation in practice. These attitudes can perpetuate a cycle of exclusion, wherein people with disabilities are not offered opportunities to prove their capabilities. In such contexts, vocational training programs play a critical role in bridging the gap between education and employment.

Comparative studies offer further insight into how inclusive vocational models can be implemented effectively. Musa (2022), in a study of vocational training outcomes for deaf students in Ghana, reported that participants benefited from targeted skills training but still faced significant employment discrimination post-graduation. While the programs provided valuable technical skills, they lacked sufficient engagement with employers or structural policy support to ensure sustained employment. This suggests that vocational training must be complemented by systemic interventions, including employer education, legislative enforcement, and post-training job placement assistance.

Best practices from vocational education programs across Europe highlight the potential of integrated, person-centered approaches. Romero-Rodríguez, Moreno-Morilla, and Mateos-Blanco (2022) detailed successful career guidance initiatives in Andalusia, Spain, emphasizing collaborative networks between schools, employers, and vocational counselors. These models offer practical examples of how to operationalize inclusive policies through sustained partnerships and tailored support systems.

At the same time, policy support must be complemented by methodological rigor in evaluating the effectiveness of vocational interventions. Single-case experimental designs (SCEDs), commonly used in special education research, offer a powerful way to assess individualized interventions (Scruggs, Mastropieri, & Casto, 1987). Researchers such as Parker, Vannest, and Davis (2011), as well as Rakap, Yucesoy-Ozkan, and Kalkan (2020), have demonstrated how non-overlap effect size calculations in SCEDs can provide clear, quantitative evidence of change, especially for small and heterogeneous populations. Şen and Şen (2019) further validated these techniques, showing their reliability for determining intervention success in settings with few participants—a frequent characteristic of vocational training programs for learners with disabilities.

Moreover, Rogers and Graham's (2008) meta-analysis on single-subject writing interventions, and Satsangi and colleagues' (2020a, 2020b) work using video modeling for students with learning disabilities, illustrate how SCEDs can inform the refinement of educational and vocational strategies. These studies show that when applied to vocational education, individualized, evidence-based practices can yield measurable gains—especially when tools such as virtual manipulatives (Shin et al., 2017) and digital schemas (Özkubat, Karabulut, & Akçayır, 2020) are integrated into training environments.

National strategies have also begun to reflect these insights. For example, the Greek Ministry of Labor and Social Security (2024) released a comprehensive national plan (2024–2030) emphasizing digital inclusion, equal work opportunities, and vocational training for persons with disabilities. Similarly, Municipal Employment Services (2010, 2016) have adopted operating regulations for vocational schools tailored to people with disabilities, offering specialized curricula and support services. These initiatives align with broader global trends aiming to shift from segregated to inclusive vocational systems.

Achieving true vocational inclusion for persons with disabilities requires a multifaceted approach that goes beyond legal mandates. While policies like the UNCRPD and IDEA lay critical groundwork, their success hinges on implementation, cultural shifts, employer buy-in, and data-driven interventions. Research continues to highlight the importance of vocational training, career guidance, and accessible tools, yet persistent barriers—such as negative employer attitudes and inadequate support services—must be systematically addressed. By uniting policy, practice, and empirical research, stakeholders can work toward a truly inclusive and equitable vocational landscape for all individuals, regardless of ability.

Conclusion:

Special education in the United States has witnessed considerable progress in recent years, driven by advances in assistive technologies, evidence-based instructional practices, and policy reforms aimed at equity and inclusion. The integration of digital tools—such as text-to-speech applications, virtual manipulatives, and video modeling—has empowered educators to tailor instruction for students with diverse learning needs, particularly those with learning disabilities. Research has played a crucial role in identifying and refining these strategies, offering promising pathways for individualized and accessible education.

Despite these advancements, significant challenges remain. Students who are Deaf or Hard of Hearing (DHH) continue to face systemic barriers in both academic and vocational settings. These include limited access to culturally and linguistically responsive instruction, insufficient interpreter services, and persistent gaps in digital assessment design. Similarly, while vocational education and career transition programs are increasingly recognized as essential components of special education, their quality and accessibility vary widely across regions and institutions. Employer attitudes, inadequate support services, and fragmented policy implementation further hinder the full inclusion of individuals with disabilities in the workforce.

To address these challenges, future research and policy efforts must prioritize large-scale implementation of proven instructional strategies and technological interventions. Equally important is the need for continuous professional development for educators, inclusive design principles in educational software, and robust frameworks for measuring program outcomes. Policymakers should also work toward harmonizing laws, funding mechanisms, and support structures to ensure a more coherent and effective special education system.

Achieving equity in special education will require a collective commitment to fostering inclusive mindsets across all levels of the educational system. By aligning innovation, research, and policy with the lived experiences of students with disabilities, the field can move closer to realizing its goal of truly inclusive and empowering education for all.

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