Navigating AI-Powered Personalized Learning in Special Education: A Guide for Preservice Teacher Faculty

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ABSTRACT

Integrating Artificial Intelligence-Powered Personalized Learning (AI-PPL) in special education teacher preparation represents a shift toward tailoring educational experiences to meet the unique needs of preservice teachers and students with disabilities. This article explores the implementation of AI-PPL tools in teacher preparation programs, highlighting their potential to customize learning experiences, provide adaptive feedback, and enhance engagement through interactive content. This review of current AI-PPL functionalities, such as adaptive learning environments and customized feedback mechanisms, demonstrates how AI-PPL can impact teaching practices and student learning outcomes. The article introduces critical attributes for successful AI-PPL integration, such as ensuring accessibility and inclusivity. It calls for further professional development to enhance educator competency and skills. By presenting real-world examples and guiding questions for special education faculty, the authors offer practical insights for educators and faculty members to effectively navigate the complexities of adopting AI technologies in teacher preparation programs.

KEYWORDS

Accessibility, adaptive learning, artificial intelligence, personalized learning, special education, technology integration

Integrating artificial intelligence (AI) in educational contexts marks a shift towards accommodating students' learning needs. AI-Powered Personalized Learning (AI-PPL) can facilitate learning environments that dynamically adapt to each learner's unique requirements, particularly in the context of special education teacher preparation. **A**I-PPL offers a pathway to tailor educational experiences, providing opportunities for preservice teachers to develop the skills needed to support all students in achieving their full potential. The *National Educational Technology Plan* identifies critical areas for development, including enhancing educational technology design, to bridge significant divides in current educational practices (U.S. Department of Education, 2024). This article meets this need by providing practical examples for integrating AI into teaching, specifically addressing the needs of preservice teachers and special education faculty.

AI-PPL tools comprise various components and functionalities, including:

- **Adaptive learning environments:** These environments are designed to tailor educational experiences to individual pacing and comprehension levels using adaptive algorithms. For example, Hashim et al. (2022) found that adaptive learning systems improved mastery of STEM concepts by providing content that aligns with students' current knowledge and learning preferences.
- **Customized feedback mechanisms:** AI-PPL platforms also integrate mechanisms that provide personalized feedback based on learners' responses. Hasibuan and Azizah (2023) conducted a study demonstrating that personalized feedback using natural language processing and machine learning can enhance student understanding and retention.

TABLE 1: Additional AI-Related Terms, Regulations, and Initiatives

Term	Definition
AI-Powered Personalized Learning (AI-PPL)	An educational approach that uses AI technologies to tailor learning experiences to individual students' needs; examples include adaptive learning environments and real-time performance analytics.
Adaptive learning environment	A system that adjusts the difficulty and type of content based on the learner's performance; for example, a math program might provide more challenging problems as a student demonstrates mastery.
Real-time performance analytics	Tools that provide immediate feedback on student performance, allowing for targeted interventions; for example, an AI system might identify areas where a student struggles and suggests additional practice.
National Educational Technology Plan	A 2024 U.S. Department of Education initiative that outlines a vision for technology in education and emphasizes the importance of accessibility and personalized learning.
Web Content Accessibility Guidelines (WCAG)	Guidelines for making web content accessible to people with disabilities; AI tools should adhere to these guidelines to ensure inclusivity.
Section 508 of the Rehabilitation Act of 1973	Part of U.S. federal law requiring that electronic and information technology be accessible to people with disabilities; AI tools used in education must comply with this law to be effective and inclusive.

- **Real-time performance analytics:** These tools offer educators detailed insights into student progress, allowing for targeted interventions. For instance, Gligorea et al. (2023) reviewed several studies and concluded that real-time performance analytics can identify learning gaps more effectively, thereby improving targeted support and interventions.
- **Interactive and engaging content:** AI-PPL tools often incorporate multimedia simulations and game-based elements to make learning more engaging for students with disabilities. Chen et al. (2021) conducted a meta-analysis showing that interactive and engaging content can increase student engagement and improve comprehension of complex concepts.

Table 1 provides additional explanations of AI terminology, regulations, and initiatives relevant to the use cases and real-world examples provided in this article.

USE CASE 1: SUPPORTING TEACHING PRACTICES AND STUDENT LEARNING

Integrating AI-PPL tools into teacher preparation programs can enhance preservice teachers' skills and significantly influence their teaching practices. Educators equipped with AI-PPL tools can offer more targeted support, identify learning gaps more efficiently, and tailor their instruction to meet the unique needs of each student (Zawacki-Richter et al., 2019). The following real-world example highlights the use of Microsoft's OneNote with Immersive Reader in special education teacher preparation programs.

Objective: Enhance preservice special education teachers' ability to use AI tools to improve accessibility and comprehension in their future classrooms

Implementation Steps:

1. Setup and preparation

- Faculty integrate OneNote into the curriculum for preservice teachers.
- Faculty create simulated student profiles, noting specific reading disabilities and preferences for use in training.

2. Introduction to preservice teachers

- Faculty conduct workshops introducing preservice teachers to OneNote and its features, including the Immersive Reader and Math Assistant.
- Faculty provide hands-on training sessions where preservice teachers explore how to use these tools effectively.

3. Practical application

- Preservice teachers create lesson plans that incorporate OneNote's AI tools.
- Preservice teachers engage in role-playing exercises to practice using OneNote with simulated students.
- Preservice teachers participate in peer review sessions to give and receive feedback on their lesson plans.

4. Daily use in simulated classrooms

- On Day 1, preservice teachers use Immersive Reader to help simulated students with reading disabilities understand mathematical problems.
- On Days 2-4, preservice teachers conduct practice sessions using OneNote's Math Assistant to solve equations and receive step-by-step guidance.
- On Day 5, preservice teachers conduct a simulated class quiz using OneNote's practice quizzes to assess understanding and progress.

5. Evaluation

- Faculty collect and analyze preservice teachers' feedback.
- Faculty use OneNote's analytics to track preservice teachers' progress in creating accessible lesson plans and identify areas needing further support.

Cost: Included in Microsoft Education products typically available to educational institutions; licensing agreements vary in cost but generally provide economical access to numerous educational tools.

Efficacy Measurement: The efficacy of OneNote in preparing preservice teachers to enhance students' mathematical understanding is judged through improvements in lesson plan quality, test scores from simulated classroom activities, and positive feedback on engagement and confidence in handling mathematical problems.

USE CASE 2: FACILITATING CONCEPTUAL UNDERSTANDING

Tailored educational content adjustments based on learners' skills can substantially boost conceptual understanding. Capuano and Caballé (2020) discussed how adaptive learning, which is closely related to AI, accelerates a learner's performance with automated and instructor interventions. Jing et al. (2023) highlighted the rapid advancements in adaptive learning research, identifying key areas like deep learning and AI education models that revolutionize educational practices. This integration of adaptive learning and AI enriches educational practices and greatly enhances students' conceptual understanding by providing personalized, skill-based content adjustments. The following real-world example demonstrates how to implement Google's Socratic app for differentiation and inclusion in special education teacher preparation programs. Figure 1 illustrates a possible daily structure for this example.

Objective: Train preservice special education teachers to use AI-powered tools like Socratic to improve accessibility and comprehension of various subjects for students with diverse learning needs

Implementation Steps:

1. Initial assessment

- Faculty conduct a pretest with preservice teachers to gauge their understanding of using AI tools for differentiation and inclusion.
- Faculty collect information about preservice teachers' experiences and expectations with personalized learning technologies.

2. Demonstrate personalized learning paths

- Faculty use Socratic to demonstrate how to create individualized learning plans for students based on their specific needs and interests.
- Faculty develop interactive problems and activities that preservice teachers can use in their future classrooms.

3. Interactive training sessions

- Preservice teachers engage with hands-on activities using Socratic to solve various subject problems. The app provides real-time feedback and adjusts the difficulty level based on the user's inputs.
- Faculty include multimedia elements such as videos and step-by-step explanations to show how AI tools can cater to different learning preferences.

4. Ongoing support

- Preservice teachers can access Socratic's scaffolding and additional resources to learn how to support students with varying needs.
- Faculty monitor the progress of preservice teachers through Socratic's analytics features, identifying areas where they need further training.

5. Final assessment

- Faculty conduct a posttest to measure preservice teachers' improvement using AI tools for differentiation and inclusion.
- Faculty collect feedback from preservice teachers on their training experience with Socratic.
- Faculty analyze pre/posttest results to evaluate the effectiveness of the training program in preparing teachers to use Socratic and make data-driven decisions for enhancing the teacher preparation program.

Cost: Socratic is a free app available on Android and iOS platforms, making it accessible to all preservice teachers.

Efficacy Measurement: The efficacy of Socratic is measured through pre/posttest results, student engagement levels, and qualitative feedback from students and teachers.

Outcomes: The activity improved preparation of preservice special education teachers in using AI tools to differentiate instruction and include students with diverse learning needs. The

FIGURE 1: Example Structure for Use Case 2

Day 1: Introduction to Socratic. Preservice teachers interact with the app to solve problems related to their subject areas.

Days 2 - 4: Daily interactive sessions where preservice teachers use Socratic to provide personalized learning experiences for simulated students.

Day 5: Final assessment and feedback collection. Faculty review analytics to identify preservice teachers' progress and areas needing further support.

FIGURE 2: Guiding Questions for Integrating AI Tools into Special Education Teacher Preparation Programs

Customization to the Classroom Environment
- Have I tailored the AI tool to align with my teacher preparation program's specific dynamics and unique needs?
- In what ways have I modified the AI tool's settings or content to better suit the diverse learning needs and preferences of preservice teachers?

Compliance with Educational Standards
- Does this AI tool comply with the educational standards and curriculum requirements of my institution and any relevant accrediting bodies?
- How does the AI tool support the learning objectives and goals of preservice teachers, especially in special education?

Required Adaptations for Accessibility and Inclusivity
- What adaptations are necessary to ensure the AI tool is accessible to all preservice teachers, regardless of their abilities?
- Have I considered all the possible barriers preservice teachers might face in engaging with this AI tool, and how can I address these challenges proactively?

Critical Analysis of Effectiveness
- Have I critically evaluated the AI tool's effectiveness in meeting the diverse needs of preservice teachers?
- In what ways does the AI tool facilitate personalized learning experiences and support the development of critical skills for preservice teachers?
- Are there any aspects of the AI tool that could potentially exclude or disadvantage any preservice teachers, and if so, how can I mitigate these issues?

interactive and personalized approach increased engagement and confidence among the preservice teachers.

USE CASE 3: AIDING MEMORY RETENTION

Quizlet is a digital tool that offers study and learning options, including flashcards, learn, write, spell, test, and match, and is designed to aid in memory retention through repetitive and adaptive learning strategies. This tool can demonstrate to preservice teachers how adaptive memory consolidation can be implemented in educational scenarios. The following real-world example features the use of Quizlet in special education teacher preparation programs.

Objective: To prepare preservice teachers to use adaptive and repetitive learning strategies to reinforce learning and retention of complex concepts in their future classrooms.

Implementation Steps:

1. Introduction to Quizlet
- Faculty introduce preservice teachers to Quizlet and its features, including adaptive learning modes and progress tracking.
- Faculty conduct hands-on workshops where preservice teachers create their own Quizlet study sets based on special education content.

2. Practical application
- Preservice teachers design lesson plans incorporating Quizlet to support students with diverse learning needs.
- Preservice teachers engage in role-playing exercises using Quizlet to simulate teaching scenarios, focusing on how to adapt content for students with learning disabilities.

3. Ongoing support
- Faculty monitor preservice teachers' use of Quizlet through classroom observations and feedback sessions.
- Faculty provide additional resources and support for integrating Quizlet into inclusive teaching practices.

4. Evaluation
- Faculty collect and analyze preservice teachers' feedback on using Quizlet.
- Faculty use Quizlet's analytics to track preservice teachers' progress in creating effective study tools and identify areas needing further support.

Cost: Quizlet offers a free version with basic features; however, Quizlet Plus is available for approximately $35.99 per year per teacher account and covers all classes with enhanced features

ABOUT THE AUTHORS

Kenneth Holman, M.Ed.

Kenneth Holman M.Ed. is a dedicated educator and researcher in the field of Special Education currently pursuing a Ph.D. at the University of Central Florida (UCF). His academic journey and professional career are marked by a deep commitment to enhancing educational outcomes for students with unique abilities. With a master's degree in Exceptional Student Education from Bethune-Cookman University, Kenneth has amassed substantial experience working with youth and young adults with disabilities in various educational settings. Kenneth's work extends beyond traditional classroom teaching; he is actively involved in groundbreaking research and development projects aimed at integrating advanced technologies into special education.

Matthew Marino, Ph.D.

Dr. Matthew Marino's research focuses on technology-enhanced solutions to improve the accessibility of curricular materials for a diverse range of learners. He develops strategic programs and partnerships to solve critical challenges in undergraduate and K-12 education. For example, he initiated the FOCUS Program designed to enhance the performance and persistence of undergraduate science, technology, engineering, and mathematics (STEM) majors. This program was developed with funding from the National Science Foundation (NSF) and is currently being scaled to other majors in two- and four-year institutions.

Eleazar Vasquez III, Ph.D.

Eleazar Vasquez III is the director of the Toni Jennings Exceptional Education Institute and professor of exceptional student education at the University of Central Florida. His research has been continuously funded since 2008 with more than $75 million from the National Science Foundation (NSF), the U.S. Department of Education Office of Elementary and Secondary Education (OESE), and Office of Special Education and Rehabilitation Services (OSERS). The goal of this research is to understand how K-12 and postsecondary students with and without disabilities can effectively learn science, technology, engineering, and mathematics (STEM) content using innovative technologies (e.g., augmented reality [AR], virtual reality [VR], video gaming, mobile applications) through interdisciplinary collaborations, lean startup models, and the Universal Design for Learning framework.

Michelle Taub, Ph.D.

Michelle Taub, Ph.D., is an assistant professor in the Department of Learning Sciences and Educational Research and core faculty of the learning sciences cluster, part of the faculty cluster initiative at the University of Central Florida. She received her Ph.D. in Psychology (Human Factors and Applied Cognition) from North Carolina State University and her M.A. in Educational Psychology (Learning Sciences) and B.A. in Psychology from McGill University. Her research focuses on using multimodal multichannel data to examine how emotional and motivational states impact the use of cognitive and metacognitive self-regulatory processes during learning with advanced learning technologies such as game-based learning environments, intelligent tutoring systems, multimedia learning environments, and immersive virtual reality.

Jessica Hunt, Ph.D.

Jessica Hunt's research supports a re-conceptualization of research and instructional practice using practices from both mathematics education and special education such that students with disabilities can build mathematics proficiency. Specifically, she designs and tests asset-based learning environments and interventions such as game-enhanced curriculums to understand, support, and extend processes of student learning. Jessica Hunt's work has three focal areas: documenting initial or informal conceptual understandings of students with learning disabilities (LD) within targeted mathematical areas (e.g., number, rational number), documenting and refining trajectories of how conceptual growth within the targeted areas occurs and can be nurtured through instruction, and designing and testing new instructional programs and practices based upon students' trajectories of learning.

Yacine Tazi, Ph.D.

Yacine Tazi is currently earning his Ph.D. in Education (Methodology, Measurement, and Analytics) from the University of Central Florida. As a TJEEI Fellow, Yacine brings in his experience and knowledge in computer programming, data visualization, and analytics. Yacine is thrilled to continue working with Toni Jennings Exceptional Education Institute throughout his doctoral program, serving the needs of children and adults through interdisciplinary research, practice, and partnerships. When he isn't working or researching, Yacine enjoys traveling and meeting people from different cultures and backgrounds.

beneficial for teachers and students.

Efficacy Measurement: The platform allows teachers with a paid subscription to track students' progress, see which terms students struggle with, and adjust the frequency and difficulty of the review materials accordingly.

CHALLENGES AND CONSIDERATIONS IN IMPLEMENTING AI-PPL

Despite the potential for AI-PPL to transform special education teacher preparation programs, several challenges must be navigated. Accessibility and inclusivity remain paramount, so AI-PPL tools must be designed using universal design principles to accommodate a broad spectrum of learning disabilities and preferences (Zawacki-Richter et al., 2019). Additionally, educators' professional development is critical, as teachers must be adept at integrating AI-PPL technologies into their instructional practices and balancing the use of technology with pedagogical strategies that foster a supportive and inclusive learning environment (Dogan et al., 2023). See Figure 2 for a list of questions faculty might consider when integrating AI tools into their teacher preparation programs.

AI represents an asset in enhancing educational practices, especially in special education settings, where it can significantly improve interactions and learning outcomes for students with special needs. AI-driven tools provide tailored educational experiences vital for addressing these students' unique challenges, supporting a more inclusive and effective educational environment (Neeharika & Riyazuddin, 2023). The primary aim of these tools is to complement, rather than substitute, the existing pedagogical efforts of teachers. Consequently, to ensure AI's effective and meaning-

Aligning AI-enhanced curricula development with UDL principles inherently addresses many accessibility concerns, facilitating the creation of educational environments that are more inclusive and engaging.

ful use in special education contexts, it is imperative to offer guidance to teachers on essential considerations as they adopt and integrate AI technologies (Marino et al., 2024).

Incorporating Universal Design for Learning (UDL) principles into AI-enhanced curricula is one essential way to create inclusive and adaptable technologies. UDL aligns with AI to dynamically adjust content presentation, interaction methods, and engagement strategies to suit individual preferences and needs by providing multiple means of engagement, representation, and expression. This adaptability not only enhances accessibility but also fosters a more profound and more personalized learning experience crucial for individuals with disabilities. AI-driven personalization features are pivotal in meeting the accessibility requirements stipulated by the Web Content Accessibility Guidelines (WCAG; 2023) and Section 508 of the Rehabilitation Act (1973), ensuring that digital curricular content is perceivable, operable, understandable, and robust. Aligning AI-enhanced curricula development with UDL principles inherently addresses many accessibility concerns, facilitating the creation of educational environments that are more inclusive and engaging. AI can help tailor learning experiences to individual student profiles, maintaining interest and motivation through interactive technologies like simulations, virtual reality (VR), and augmented reality (AR). Such technologies immerse learners in highly interactive environments that simulate real-world scenarios, making learning more engaging and hands-on.

CONCLUSION

Adopting AI-PPL in special education teacher preparation programs holds the potential to revolutionize the educational landscape for students with disabilities (Marino et al., 2024). By fostering an adaptive, personalized learning environment, AI-PPL tools can enhance student engagement, facilitate a deeper understanding of complex concepts, and support the acquisition of procedural knowledge and skills. However, successfully implementing AI-PPL requires careful consideration of several key factors, including the customization of AI tools to fit classroom dynamics, adherence to educational standards, and the necessity for adaptations to ensure accessibility and inclusivity. Analyzing AI's effectiveness in meeting diverse student needs is the most pressing concern. As we navigate the future of education, educators and faculty members must equip themselves with the knowledge and skills to integrate AI technologies thoughtfully and effectively into their teaching practices, thereby enriching the learning experiences of students with disabilities and paving the way for a more inclusive educational system.

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