The Past, Present and Future Use of Artificial Intelligence in Teacher Education

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ABSTRACT

The use of artificial intelligence (AI) is not a new concept. Still, the press, the worry, and the hype around the potential benefits and limitations of the explosion of these tools in this field is a current topic in teacher education. In this article, the authors summarize the past use of AI, present easily adaptable tools in teacher education, and discuss what is on the horizon in industry and special education teacher education. The authors highlight tools that should be considered in programs today, followed by ways to expand the field of AI in teacher education to support the learning outcomes of struggling students.

KEYWORDS

Artificial intelligence, accommodations, inclusion, innovation, modifications, special education, student learning, teacher preparation, technology

Over the past 4 decades, the role of educators has changed. The role of an educator is moving from one who delivers knowledge to one who facilitates learning, critical thinking, and problem-solving (Brady et al., 2023). Special education teachers are expected to provide intensive intervention in areas of identified deficit through either co-teaching or direct instruction within inclusive settings to students with various academic and behavioral needs. The considerable demands on special educators to collaborate with caregivers, service providers, and general education teachers; individualize instruction for every student on their caseload; make time for developing and monitoring student goals; train paraprofessionals; and manage daily tasks has led to high turnover rates, stress, and burnout (Brady et al., 2023; Rock et al., 2023). Non-instructional tasks (e.g., lesson planning, grading, content development) significantly contribute to increased workload for all teachers (Higton et al., 2017) and burnout (Agyapong et al., 2022). Burnout leads to heightened absenteeism and low job performance (Klusmann et al., 2016). To counteract this stress, educators are seeking to adopt technologies to reduce workloads and increase time for instruction (Silva et al., 2023).

Many practices and tools within artificial intelligence (AI) in education (AIEd) support both preservice and in-service special education teachers. Technologies, such as chatbots, prediction platforms, automated grading systems, and intelligent tutoring, not only improve educational outcomes (Chiu et al., 2023a) but can also provide automated AI agents to answer questions and give students immediate feedback on assignments. The ability of AI to automate administrative tasks and facilitate specially designed instruction can provide educators with increased time, the number one issue noted by special education teachers, to focus on personalizing instruction and creating a motivational environment (Al-Mughairi & Bhaskar, 2024). Increased time has also reduced educator stress and burnout (Yin et al., 2021). When understood and used appropriately, AIEd can support special education teachers in instructional content development, planning, assessments, modifications, adaptations, and communication (Hashem et al., 2024) aligned with students' individualized education program (IEP) goals.

Past to Present: The History of AI

AI has existed for over 70 years, yet numerous definitions of the term exist (Luckin et al., 2022). For this paper, AI is defined in its original meaning: any interactive machine capable of mimicking human intelligence (McCarthy et al., 1955). Generative models within AI date back to the 1950s (i.e., hidden Markov models, Gaussian mixture models). Logic Theorist was the first AI program developed. However, it was only in the addition of deep learning that generative models became popular (Ciesla, 2024). The first commercialized AI involved robots (Shakey [1966], WABOT-1 and Stanford Cart [1970], and WABOT-2 [1980]). The concept of AIEd was introduced with the creation of the Turtle robot and computational LOGO in the 1970s (Papert et al., 1971).

One of the most popular OpenAI bots to date, Chat Generative Pre-Trained Transformer (ChatGPT), had predecessors dating back to 1950 with Alan Turing's Turing Test. The Turing Test sought to discover whether a computer could communicate with people without humans realizing the communication was occurring with an artificial entity (Adamopoulous & Moussiades, 2020). The first AI chatbots, Eliza (1966), Parry (1972), Jabberwacky (1981, later termed Cleverbot in 1990), Alice (1995), and Deepblue (1997) led the way for future, more sophisticated bots such as IBM's 2010 Watson; Apple's 2011 Siri; Amazon's 2014 Alexa and 2017 Lex; Microsoft's 2014 Cortana and 2018 Xiaoice; Google's 2020 Meena and 2023 Bard; Meta's 2022 Blenderbot; and OpenAI's 2022 ChatGPT (Ciesla, 2024). The popularity of chatbots was solidified when, within two months of its launch, ChatGPT became the fastest-growing app in history (Makridakis et al., 2023).

Today, AI is being used daily by special education teachers for personalized instruction, social dialog, scaffolding, collaboration, experiential learning, and much more (Luckin et al., 2022). Chatbots can answer questions and engage in real-time conversations with users. An in-depth interview with 34 educators on their willingness to adopt AI in their classrooms (Al-Mughairi & Bhaskar, 2024) revealed educators who integrated ChatGPT had enhanced technology skills and were more likely to stay engaged with future technologies. In recent years, AI has become so user-friendly that special education teachers working in transition settings are able to provide specially designed instruction to K-12 students using machine learning models without a computer science background through tools such as TensorFlow Playground and Teachable Machine (Wangenheim et al., 2021). These tools, when mastered in preservice preparation programs, can be equipped to better prepare students for the future workforce, which is especially important for students in transition programs (Miao & Shiohira, 2022). To continue this expansion, the field of teacher education needs to guide students in using AI effectively as an efficient helper rather than a replacement for human interaction or critical thinking (Ausat et al., 2023).

Educators need to prepare preservice special education teachers on how to use AI tools to provide personalized support through a variety of services, including (a) summarizing lessons, (b) answering questions, (c) modifying content, (d) providing recommendations on student goals, (e) providing insight on existing content, (f) designing assessments, and (g) generating questions, lessons, and activities (Al-Mughairi & Bhaskar, 2024; Baidoo-Anu & Ansah, 2023; Sun & Hoelscher, 2023). Although a primary benefit of AI is its easy access to information (Sun & Hoelscher, 2023), this same benefit causes ethical questions regarding AI's usefulness within education (Hosseini et al., 2023) and specifically how teachers are personalizing learning aligned with students' IEP goals and objectives.

Concerns Over the Use of AI in Education

The capacity for AI to assist educators in administrative tasks and motivate students has been displayed in numerous systematic reviews of AI within education (Chen et al., 2020; Laupichler et al., 2022; Ng et al., 2023a, 2023b; Salas-Pilco et al., 2022; Sanusi et al., 2023; Su et al., 2022; Tan et al., 2022; Wangenheim et al., 2021; Zawacki-Richter et al., 2019). Research shows the integration of AI should be purposeful in teacher education, as the potential exists for a decline in the quality of education if teachers become over-reliant on AI (Chiu et al., 2023a). For example, AI can create SMART goals for students' IEPs. However, the educator must have knowledge of how these prompts should be written to ensure they are created and aligned with students' needs and where the chatbot is gathering information to create the prompts (i.e., is it from a knowledgeable, diverse, and valid source). Educators must also understand how to modify the output from these prompts to meet the individual student's needs. Prompt generation and output modification are critical new components of instruction within any special education teacher education program.

Several factors are essential for teacher educators to consider when preparing preservice special education teachers for AI use within classrooms. These factors can lead to the misuse of AI, including whether the following are present: (a) biased and discriminatory results that may not reflect the population of students the teacher is serving; (b) misinterpretation of data and communication; (c) reduced reliability and accuracy of information aligned with the students specific goals or objectives; (d) reduced interaction with students if AI is the default for instructional use; (e) fewer opportunities for building relationships through collaboration and teamwork when "auto" created lessons and activities are the default; (f) over-reliance on technology

negating preparing students with disabilities to think on their own; (g) reduced problem-solving and critical thinking; (h) decreased privacy and data security; and (i) potential copyright infringements (Arif et al., 2023; Hosseini et al., 2023; Sallam, 2023). Awareness of these concerns is critical in preparing special education teachers as it helps educators understand the scope of the positive and negative impacts of AI tools. A breakdown of some of these critical considerations follows.

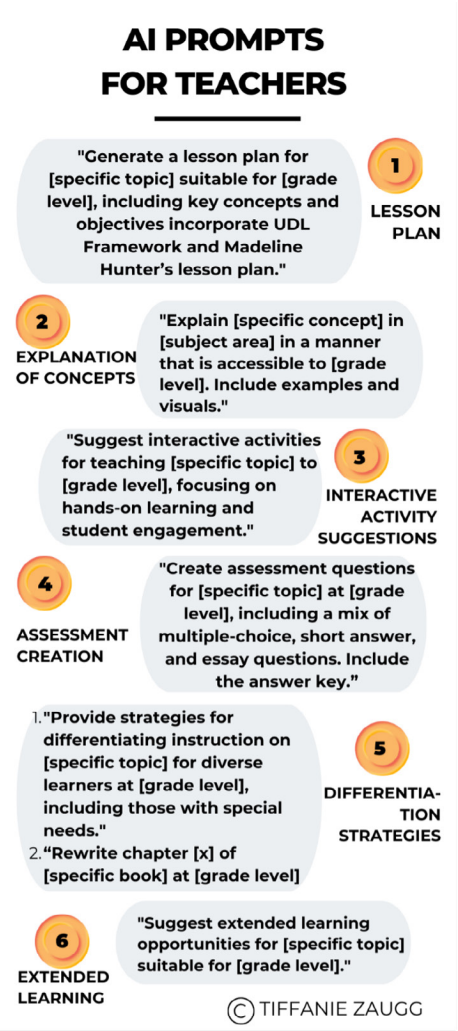
Misinformation

AI may provide factually incorrect information, including misconceptions, biases, and inaccurate data (Zhou et al., 2023), especially when the inclusion of disability in current databases of knowledge is potentially limited or unknown. Ensuring preservice teachers understand the biases, inadequacies, and inaccuracies within the pattern-finding mechanism, training, and data sources is a critical new component of preservice preparation. Possible solutions in teacher preparation include being able to provide teachers with how to access accurate data by: (a) providing engineered detailed prompts within search features (see Figures 1-3), (b) pulling data from knowledgeable databases created by trusted experts (e.g., Custom GPT), (c) providing specific questions within the prompt of what kind of response is warranted and in what vernacular, (d) creating a clear pedagogical focus for AIEd's use, and (e) using AIEd as one source within many sources to enhance or gather outside thoughts and perspectives, rather than replace human interaction and data collection.

It is also helpful to consider preparing teachers to reflect on core questions before using AI data. These reflective questions might include: "Was the data on which the AI was trained representative of the population affected by subsequent decisions?" "Is the advice or information given well-balanced and derived from an analysis of information from trustworthy sources using effective methods?" "Was the data on which the AI system was trained properly representative of the population affected by AI output or insights?" "Is the data derived from pattern-finding methods, and if so, were there biases within this source data?" Teacher candidates need to understand the source of the data they are seeking to ensure inclusivity of the population they are serving. This may require preservice teachers to look at the cited sources given by the AI tool to ensure it is built upon peer-reviewed and evidence-based practices in the field.

Teachers must also understand how the prompt placed within AI content generators influences the output. For example, a special education teacher working with a high school student with extensive support needs can assist the student in creating a resume of their skills for a job. Then, the educator can show the student how to attach the resume to the search bar using Microsoft CoPilot (https://copilot.microsoft.com/). The student can be trained on entering different prompts for different purposes, such as "Use the attached resume to create a cover letter for this LinkedIn job description as a communications greeter for the Johnson Public Library in Overland Park, KS." CoPilot will type a letter, pulling from the resume and matching it to the job description and key information from LinkedIn and the Johnson County Library website. The teacher would then show the student the links at the bottom where it pulled this information and help determine if these are the correct links for the job. If they are, the next task would be asking CoPilot to read the letter aloud and having the student follow along, noting any misinformation or mistakes. They could then work together on correcting any mistakes and adding any additional content to the cover letter. They would ask CoPilot how to cite its assistance on this task and add this citation to the bottom of the letter.

FIGURE 1: Sample Graphic for Preservice Teachers to Explore AI for Professional Tasks



Reflecting with future educators on examples of how to assist students with both the input and the output of AI-generated tasks is imperative. The student and teacher could go on to create cover letters based on the resume for a specific university or other jobs that fit the student's skills. They can even ask CoPilot to list jobs based on the resume the teacher guided the student in writing. Figure 1 provides examples of forms of prompts to assist educators in understanding the need for precise, detailed prompts stating who the content is being generated for, in what format

TABLE 1: Free and Low-Cost Educator Applications

Application Purpose	Free & Low-Cost Applications With These Capabilities			
Content Summarizer/Generator	ChatGPT	Midjournery	Microsoft Copilot	CustomGPT
Image Editor/Generator	Lensa	DALL·E 3	OpenArt	Craiyon
Video Editor/Generator	Fliki	Runway	HourOne	Synthesia
Audio Editor/Generator	Podcast AI	Listnr	Coqui	Wellsaid
Writing Editor/Generator	ParagraphAI	Grammarly	HyperWrite	Claude 3
Analyzing Data	DeepMind	AI Notebook	Stability AI	AnswerRocket
Personalized Instruction	PopAi	Sizzle	Flexi	Khanmigo
Assessment Tools	Twee	Quizalize	Almanack.ai	Magic School
Character/Meme Assistants	Character.ai	Super Meme	Artflow.ai	Free AI Assistant
Productivity Assistant	Brain.fm	Otter	NotionAI	Zapier
Presentations/Designs	Canva	Adobe Firely	Microsoft Designer	Gamma

Note: A supplemental resource can be found at: https://docs.google.com/document/d/1TeN8LeOl-puwiY7vsWvHUU26jAl3rlAaCWklv21Np04/edit?usp=sharing, which shares how to use each of the above resources. Many of the applications listed above have multiple functions and can be used in addition to what is listed within this chart. Most of the above apps have free and paid subscription versions.

the output is expected, and why.

Safe and Ethical Use

Utilizing AI effectively requires both safeguards and reflective practice. Particularly, educators should consider what data is best collected or what information is best discovered using AI, who will be involved with the AI, what other options are available that may be more advantageous, how will AI analyze and evaluate information, and how will this data relate to and inform practices. Professional development (PD) for ethical AI implementation can help educators avoid misuse (Ng et al., 2023a). The PD should include instruction on AI's capabilities, uses, and limitations; examples of how AI may be effectively incorporated into the classroom; and current technological aspects of AI.

AI to Support Educators

The United States is one of many countries developing a national AI strategic plan (Laupichler et al., 2022). Despite evolving guidance and frameworks, educators often interact with AI without realizing the algorithms, software, and applications embedded within tools such as Google Classroom, Excel, PowerPoint, chatbots, podcasts, and YouTube. For example, when creating an Excel spreadsheet of student data, Microsoft utilizes AI to provide an array of possible visual methods for best presenting the data. PowerPoint presentations now have AI-powered design generators that provide ideas on how best to display the content on blank slides. Siri answers a question or types a text based on information spoken into the teacher's phone. Other applications utilize AI more overtly (i.e., editing such as Grammarly and adapting content like Magic Write, AudioPen, Curipod, EduAid, Ludia, and Goal Genius). Keeping in mind the safeguards noted, Table 1 provides a listing of a few common AI applications used to assist educators, as well as a description of how authors may use this tool and how an AI chatbot recommends using the tool. There are many tools available to create content from a prompt (e.g., https://poe.com/, https://app.magicschool.ai/tools, https://www.perplexity.ai/, https://claude.ai, https://gemini.google.com/, https://www.khanmigo.ai/, and https://www.comm100.com). It is important to provide educators with a few of these top tools and discuss how these tools may be helpful in performing in a manner such as presented in Table 1.

Administration, Logistics, and Time Management

AI has the capacity to simplify administrative tasks (Shumanov & Johnson, 2021) without taking over instruction by providing special education teachers with time-saving tools for tracking attendance and behavioral information, such as Poll Everywhere's Attendance Management (Karsenti, 2019). Preservice teacher preparation programs need to create a model for teaching various AI tools. For example, preparation programs may want to support teachers using apps like ReportGenie and Grow to input IEP information for report cards and produce printouts of student progress or import Google Sheets data to create visualizations for parents. AI can assist educators in language translation and pronunciation of words in other languages (Hashem et al., 2024). Apps are even

available to locate objects or information promptly (Mosher, 2022). The free or low-cost apps PictureThis and Leafsnap use visual recognition software to identify a plant, state the species, provide care information, and give details on where the plant may best be located. When walking with students, teachers can take a picture of a plant or tree and receive the plant's origin, watering specifications, and methods to treat the pictured plant's common pests. Special education preservice teachers need a universal design for learning (UDL) mindset to explore, understand, and adopt AI tools during their preservice program to help ensure their future success and use of AI in their classrooms.

Planning and Goal Setting. With AI apps, portable devices can provide immediate content, even on the go. For example, Pearson and McGraw-Hill offer digital learning platforms that can be accessed from the teacher's phone. Teachers can adjust course content through learning management systems such as Moodle and Coursera. AI-powered goal-setting tools can help educators determine realistic goals, track progress, and adjust goals based on individual performance and achieved milestones (Baidoo-Anu & Ansah, 2023). Other examples of tools preservice preparation programs in special education can use are GoalGenius.ai, IEP CoPilot, and TaskAde to assist in generating ideas for IEP goals educators can use as prompts.

For example, one professor challenged students in a special education language and literacy class to use the tool of choice to complete two tasks. The first was to create summaries from a chapter in *Because of Winn Dixie* at the 100 and 800 Lexile levels. The preservice teachers were then tasked with using an image generation program to create image prompts that students could use to write a paragraph aligned with the task. This activity concluded with the preservice teachers being asked to translate the passages into two other languages for two students: one who spoke German and had an identified disability and another English language learner who shared that Spanish was the only language spoken in the home. This activity not only showed the efficient use of AIEd tools but also provided a way to think about scaffolded texts, language translation, personalized content, and differentiation.

The second activity the professor planned was integrating into the teacher preparation prompt engineering and UDL lesson development. Using the same book, the teachers were asked to prompt ChatGPT to create a lesson plan. They were then asked in small groups to critique the plan and develop three more prompts (one focused on UDL, one on ideas aligned with a specific disability, and one on identifying creative ways to assess learners). These students then compared, critiqued, and contrasted what they found and submitted their original and advised lesson plans. Finally, they were asked to use videos uploaded to the course site to discuss what they learned regarding the strengths, weaknesses, and ethics behind using AI tools.

Assessing and Grading. Providing ongoing and immediate feedback is a critical and often difficult skill for new teachers, and essential for ensuring learning mastery and assessing progress toward IEP goals for students with disabilities. Algorithms from AI can provide immediate grading on student assessments (Gran Ekstrand et al., 2021), and AI-powered chatbots have the capacity to provide automated learning assessments based on the goals teachers input into the chatbot (Durall & Kapros, 2020; Tlili et al., 2023). Gradescope, Autolab, and AI Tutor collect assessment results, evaluate the results, and provide feedback, allowing a quicker response rate based on data than many current methods of data collection and helping the teacher adapt instruction (Okonkwo & Ade-Ibijola, 2020). AI even has the capacity to monitor how students process information (Chiu et al., 2023b) and provide adequate feedback.

AI has proven helpful in teacher-student communication after assessments through methods such as promoting self-reflection and recommending adaptive teaching strategies (Timms, 2016). AI apps can collect and analyze data from multiple sources (Muljana & Luo, 2021) and provide insight into students' learning processes and possible methods of support (Jia et al., 2021). For example, Carnegie Mellon University's free authoring tool, LightSIDE (Kumar & Sree, 2014), provides automated essay scoring using syntactic elements based on answers to specific questions educators input before the assessment. The UTIFEN platform, used by educators in the Republic of Niger in West Africa, promotes mobile learning and has the potential to analyze individual successes and failures to create data-based interventions. The platform sends automated reminders to students throughout the intervention and provides personalized feedback on accomplished goals and milestones. AI's ability to automate time-consuming administrative tasks (i.e., grading, attendance, progress monitoring) has the potential to save educators key instructional time daily.

Supporting Personalized Student Instruction

Emerging tools offer promising pathways to personalize and enhance students' learning and executive functioning skills while reducing the burden on teacher time (Mosher et al., 2020). AI tools are becoming more advanced (Carew, 2020) and prevalent. Teacher educators and the teachers they prepare need to integrate these tools into preparation and practice. Educators can create personalized, inclusive experiences by incorporating AI to meet students' diverse needs. Teachers can use AI to assist students in various tasks across reading, text generation, cognitive scaf-

folding, physical and sensory areas, and executive functioning. Examples of how AI can help support students are provided below.

Reading and Comprehension. Various AI tools foster motivated reading practice by generating or recommending reading materials based on student interests, reading proficiency, and learning goals (Li et al., 2023). AI algorithms assessing reading levels can dynamically adjust texts to appropriate difficulty, ensuring comprehension and engagement. Chatbots and intelligent tutors can provide coaching and support when a peer or adult is unavailable. These platforms can analyze reading patterns and adaptively adjust the difficulty level of texts and instruction to match individual students' proficiency levels (Sarker, 2021).

Leveled and Generated Text. As noted in the example of the use of AI in special education teacher preparation, emerging tools in the AI realm can quickly and efficiently screen for reading fluency and decoding problems and provide potential interventions (Erbeli et al., 2023). Eye-tracking technology, combined with AI and previously established machine learning software, shows promise in streamlining the identification of reading disabilities (Gran Ekstrand et al., 2021; Benfatto et al., 2016). Kim and Wiseheart (2017) and Rello and Bastelaros (2015) examined the unique patterns of eye movements between children with and without dyslexia, and AI is taking this information to generate applications capable of noticing these differences. Text-to-speech technology integrated into reading apps can assist students with reading difficulties by providing audio narration. AI algorithms can highlight keywords, provide definitions, and offer contextual explanations to aid comprehension. AI can generate personalized stories tailored to students' interests and reading levels, promoting engagement and comprehension with interactive quizzes or branching narratives.

Accessible Formats and Differentiated Instruction. Current tools can generate compelling and creative lesson plan activities and content (Pavlik, 2023). AI can simplify and motivate students through summarization and game-like activities (Jovanović & Milosavljević, 2022). AI applications can create personalized texts in various formats (audio, braille, translations), catering to students with visual impairments, learning disabilities, or language barriers. AI-powered writing assistants can help students generate coherent and well-structured written content. These tools can provide suggestions for improving grammar, vocabulary, and style while offering real-time feedback on the written content. Natural language generation models can automate the creation of study guides, summaries, and other materials based on input from textbooks, articles, and notes. AI-driven tutoring systems can provide personalized learning experiences by adapting instructional strategies to students' cognitive abilities, learning styles, and preferences. Intelligent tutoring systems can identify areas of difficulty or misconceptions and offer targeted interventions, explanations, and practice exercises to master concepts.

Cognitive Scaffolding and Executive Functioning. AI-powered tutors can provide real-time feedback on comprehension, vocabulary understanding, and inference skills, adapting to individual needs and learning styles. For example, teachers can create a bot for their classroom in a specific area of difficulty while exploring already existing or emerging AI tutors (e.g., Kahnamigo). AI tools can guide students in reflecting on their reading process, identifying strengths and weaknesses, and developing self-regulated learning strategies. To enhance various components of executive functioning, AI may provide personalized support, feedback, and guidance to students across different stages of their academic journey. For example, Hughes et al. (2022) created an AI agent combined with biometrics to help students with disabilities self-regulate in general education settings. To improve social communication, self-regulation, and critical thinking skills, AI was used to help create an extended reality program (Mosher et al., 2024) that supports skill development in over 180 social skills through 140 scenarios. The potential benefits for students with executive functioning challenges and pragmatic delays are significant, and ongoing research explores new and innovative supports.

AI in Teacher Preparation

The Council for the Accreditation of Educator Preparation (2018) declared technology a cross-cutting theme in its teacher education requirements, and effective faculty modeling of technology use in teacher preparation is emphasized in the Teacher Educator Technology Competencies. Teachers' beliefs regarding technology use are strongly influenced by the program design of their teacher preparation experiences (Voithofer & Nelson, 2021). This creates new challenges and opportunities in preparation. To fully maximize the potential of AI, teachers need to understand its applications, barriers, and potential as they enter the classroom (Basilotta-Gomez-Pablos et al., 2022) through effective modeling.

Pedagogical Shifts

AI tools challenge teachers to rethink pedagogy and assignments, forcing teacher educators to determine how this shapes programs and curricula. Even technological approaches need to be reconsidered with the advent of tools that remove the need for sophisticated skills. For example, the TPACK framework focuses on technological, pedagogical, and content knowledge (Voithofer & Nelson, 2021). With AI, the technological and content load are reduced. AI searches can produce content in seconds, and few new technology skills are needed to

operate the latest AI interfaces. In higher education, the pedagogical category specifically calls for rethinking teaching and learning for the success of future students.

Shifting to more student-centered use of technology, inquiry-based teaching activities, and other constructivist approaches requires a shift in instruction and a change in mindset at the teacher preparation level. While educators may recognize the benefits of promoting critical thinking, problem-solving, and a deeper understanding among students, many still use traditional reductionist teaching that aligns well with standardized testing and traditional assessment methods. The real power or danger in the use of AI is in either promoting or not promoting critical thinking, problem-solving, and a deeper understanding among students, which align with an array of emerging assessment methods. Just as new AI-driven adaptive learning systems can dynamically adjust the difficulty level of content based on a student's performance and progress, they also offer new ways of assessing learning based on individual needs and goals. Teacher preparation programs can help new educators understand how to use AI to guide students through constructing knowledge, problem-solving, and developing meaningful forms of assessing new learning.

AI tools challenge educators to focus on student-centered approaches, customized learning, and a greater reliance on creative thinking. Adaptive learning systems automatically respond to student needs and allow them to be consistently challenged without feeling overwhelmed or bored (Smith et al., 2022). The need for differentiation to be accomplished solely by the teacher is relieved through automation, allowing time for teachers to interact with, coach, and develop students' deeper understanding (Carreon et al., 2022). Developing the right questions to ask to solve a problem becomes a critical skill when answers are easily

FIGURE 2: Screenshot of Custom ChatGPT Response to Prompt to Create Sample Progress Monitoring Chart

Assessment Details:

- **Assessment Type:** Two-Digit Addition
- **Goal:** Add two-digit numbers with 90% accuracy

Progress Monitoring Chart:

DATE	NUMBER OF PROBLEMS	CORRECT ANSWERS	ACCURACY (%)	COMMENTS/STRATEGIES USED
01/08/2024	10	7	70%	Used fingers to count
08/08/2024	10	8	80%	Used number line
15/08/2024	10	9	90%	No manipulatives
22/08/2024	10	10	100%	Mental math
29/08/2024	10	9	90%	Used hundreds chart
05/09/2024	10	10	100%	Mental math
12/09/2024	10	10	100%	Mental math

Comments and Observations:

- **01/08/2024:** Student relied heavily on fingers for counting.
- **08/08/2024:** Introduced number line; student showed improvement.
- **15/08/2024:** Student was able to solve problems without manipulatives.
- **22/08/2024:** Student achieved perfect score using mental math.
- **29/08/2024:** Used hundreds chart for verification.
- **05/09/2024:** Consistently achieving high accuracy with mental math.
- **12/09/2024:** Maintained perfect score with mental math.

Intervention Phases:

- **Primary Instruction:** Initial assessments and introduction of basic strategies.
- **Secondary Intervention:** Use of manipulatives and visual aids.
- **Tertiary Intervention:** Focus on mental math and advanced strategies.

Goals and Adjustments:

FIGURE 3: Screenshot of Response to Prompt to Create Chart in Undergraduate Teacher Prep Course

Creating a progress monitoring chart for a second grader learning new vocabulary words involves several steps. Here's a simple guide to help you set up and use the chart effectively:

Step 1: Define the Goal

Set a clear, measurable goal for the student. For example, "The student will correctly identify and use 20 new vocabulary words by the end of the semester."

Step 2: Choose a Measurement Tool

Select a tool to measure the student's progress. This could be a weekly quiz, flashcards, or a vocabulary game.

Step 3: Administer and Score Probes

Administer the chosen measurement tool at regular intervals (e.g., weekly). Score the student's performance each time.

Step 4: Create the Chart

You can create the chart using graph paper or a digital tool like Excel. Here's a simple example of how to set it up:

Horizontal Axis (X-Axis)

- Label this axis with the weeks of instruction (e.g., Week 1, Week 2, Week 3, etc.).

Vertical Axis (Y-Axis)

- Label this axis with the number of vocabulary words correctly identified and used (e.g., 0, 5, 10, 15, 20).

Step 5: Plot the Data

Each week, plot the student's score on the chart. Connect the data points with a line to visualize progress over time.

Example Chart

WEEK	WORDS CORRECTLY IDENTIFIED AND USED
1	5
2	7
3	10
4	12
5	15
6	18
7	20

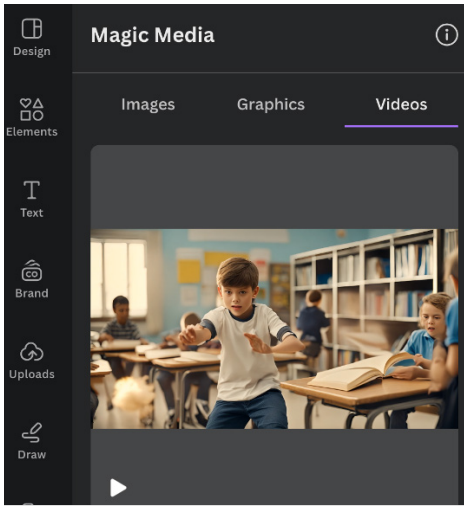
accessible. Validating resources and drawing (and challenging) conclusions generated through AI are essential skills, giving communication and collaboration higher value.

Samples and Consideration for AI Use

As noted in Technology Vision (2024), AI and large language models (LLMs) are moving fast, and by the time the report was published, new best practices for building generative AI advisors already existed. Preparing for the speed of change is a challenge at all levels of education, but flexible thinking in preparing future teachers is essential to ensure learners with disabilities have access to AI tools as they evolve. In the short term, content experts in education could create their own custom chatbots or AI assistants to direct students to avoid the generic output of LLMs like ChatGPT. More refined and specific small language models will control the quality of content and can easily be created with products like Custom GPT (https://customgpt.ai). Examples of two separate sample inputs to create a progress monitoring chart using a customized chatbot, Education and Learning in an Inclusive Environment (EL*;* Zaugg, 2024), are shown in Figures 2 and 3. These were prompts written into an AI assistant created to search more than 5,000 reputable open-source educational resources (e.g., IRIS modules, high leverage practices, CAST, journals) to provide immediate and direct access to reputable solutions for preservice and in-service teachers. This EL AI assistant is a free tool available to educators.

Figure 2 shows a prompt given to the EL AI assistant to create a progress monitoring chart for two-digit addition. Figure 3 presents a sample response the EL AI assistant generated when asked to create a progress monitoring chart for a teacher preparation course. As shown in the figures, the specific words added to or removed from a prompt change the output of the information provided. This is why it is imperative to teach users where to locate chatbots that pull information solely from validated sources and how to write specific, detailed prompts to get the desired output.

FIGURE 4: Screenshot Using AI-Powered Magic Media in Canva



Zaugg (2024) used a quasi-experimental research design to analyze the effects of AI assistant usage among preservice teachers who watched a 10-minute video overview demonstrating how to use an AI assistant to create lesson plans that include accommodations and modifications. Students in the study created lesson plans that were ranked significantly better by outside evaluators than those of a control group that heard the same lecture on accommodations and modifications but did not receive specific examples of how to use the EL AI assistant for such assignments. Students also completed the lesson plans in a fraction of the time needed compared to their control peers. The study additionally examined the correlation between the use of AI assistants and the likelihood that preservice teachers would allow their future students to use AI tools. Results indicated a significant change in the attitudes and practices of preservice teachers regarding AI, with notable improvements in their familiarity and ethical considerations of AI use in educational settings.

Beyond searching for content and creating classroom resources and tools, AI allows users to create new practice opportunities for preservice educators (Misra et al., 2019). Song et al. (2022) evaluated the effects of a teaching simulation activity using a chatbot on preservice teachers' efficacy. The researchers asked 46 preservice teachers to teach a chatbot about school violence and how to handle it. The results of their research suggested that designing this content provided preservice teachers with opportunities to increase their teaching efficacy. Teacher preparation programs that provide opportunities for students to utilize innovative technologies produce educators who show greater comfort and competency with these technologies (Mosher & Carreon, 2021).

With new tools emerging daily that allow users to generate videos from basic written descriptions, teacher educators can go even further by creating limitless scenarios for future educators to explore and create. The ability to create video-based training materials is linked to the teacher's ability to describe the desired scenario, which improves teacher pedagogy. Tools such as Canva, a user-friendly graphic design platform that allows users to create a wide variety of visual content, are particularly popular among non-designers due to their simplicity. Canva now includes Magic Studio, an AI-powered platform that creates video clips and images using a simple written prompt. Figure 4 shows a screenshot of a classroom scene created by the Canva AI-driven Magic Studio feature with the prompt, "Create a boy throwing a book in the classroom." More sophisticated AI video-generation programs are also available at varying prices and allow educators to create realistic scenarios that can be used to prepare novice teachers for unlimited classroom situations.

Future Use of AI in Special Education Teacher Preparation

The future of AI in teacher education has the potential to transform the profession by addressing the high levels of stress and burnout among educators attributed to their extensive workload. AI in education encompasses technologies like chatbots, automated grading systems, and intelligent tutoring, all promising to impact the future of teaching and learning. The evolution of AI from its inception over 70 years ago, with the development of the first AI program to the introduction of AIEd in the 1970s, has led to its current integration into classrooms for various purposes. The subsequent rise of AI chatbots has provided the foundation for increasing personalized instruction and social dialog.

The pace at which AI continues to evolve is exponential and important to consider in teacher preparation (Fonseca et al., 2024). The future use of AI is something even AI cannot predict. For example, a study of LLMs (e.g., GPT-4) within medicine showed that AI already has capabilities to extensively analyze vignettes, interpret stories, and provide an accurate diagnostic hypothesis based on the data at a mean success rate of 71.3% compared to the neurologists' success rate of 69.2% (Fonseca et al., 2024). This means educators in the future may be able to accurately use AI to identify interventions for a struggling student and create a hypothesis as to why a student is struggling with greater accuracy than a single educator alone. This also means that in the future, if provided with reputable and accurate source data, AI may be able to make meaningful analysis and predictions with less biased results.

A study of 51 students from three research-intensive universities identified themes students believe future higher education institutions must provide future educators (Chiu, 2024). These themes include new learning outcomes involving AI literacy, interdisciplinarity, maker learning, and assessments centered around in-class, hands-on, relevant activities. Teaching future educators how to implement multiple formative assessments is imperative to ensure generative AI is not used just to generate answers but instead provides meaningful measures relevant to students in the future workforce.

Future teacher preparation for special education is likely to focus on the use of AI to create personalized and inclusive learning environments. AI tools can generate adaptive learning systems that tailor educational content to each student's unique pace and style, providing a more individualized experience. AI can also assist in managing classrooms by tracking student progress, adapting learning plans, and offering real-time analytics based on student performance.

A survey of 2,778 published researchers in top-tier AI Journals predicted that by 2047, there is a 50% chance that AI will be able to autonomously create a product (e.g., song, story, picture) indistinguishable from or outperforming one created by a popular human in that decade (Grace et al., 2024). Respondents also predicted a 10% chance that by 2037, human occupations will become fully automatable. The predictions of these researchers reveal to teacher preparation programs the importance of future educators instructing students in areas such as critical thinking, communication, and collaboration, skills that will continue to be imperative no matter what occupations are available in their students' futures.

One of AI's greatest potential uses is personalized data-driven feedback. With the evolution of tools in data tagging and teacher and student performance observation, learning tasks can move from subjective to objective analyses. AI can analyze data to provide direct, personalized methods to remediate deficits in teacher performance, impacting student learning (Hashem et al., 2024). Furthermore, AI can provide targeted interventions from this analyzed data in seconds, enabling teachers to address each student's needs. Incorporating AI into teacher preparation programs will require careful consideration of ethical implications, such as ensuring privacy and avoiding bias. The integration of AI will also necessitate training future educators on imperative safeguards, such as never placing students' identifying information into any AI technology not stored on local district-protected servers and teaching their students these safeguards.

Future pathways for the use of AI include personalized learning in immersive environments. AI systems can tailor preservice teachers' learning in their university courses, and then they can use these tools to customize instruction for their students. Realistic simulations of classrooms with students who have special needs (Berg et al., 2023; Dieker et al., 2023) and simulations of various tasks, including learning and workforce training (Mosher & Carreon, 2021), already exist and have data supporting their effectiveness in education. The integration of AI can improve these simulations to provide real-time responses from realistic avatars without the need for humans to staff the behind-the-scenes responses, allowing preservice and in-service teachers to practice new skills in a safe environment while receiving AI-driven feedback on their performance.

By providing personalized learning, simulations, data-driven feedback, and assistive technologies, AI can help ensure all students have access to qualified and effective teachers and reach maximum learning outcomes. For this to occur, a call for action is needed for AI to be integrated into programs today. It is imperative that with this call, AI users are encouraged to continue using innovative technology with constant reflection and expansion as new tools evolve to support teacher and student learning outcomes.

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