Exploring the Integration of Artificial Intelligence into Special Education Teacher Preparation through the TPACK Framework

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ABSTRACT

With the introduction of artificial intelligence (AI), specifically generative AI and large language models (e.g., ChatGPT, Google Gemini), into education, there is a conversation regarding what knowledge teachers still need and will need moving forward. In this article, we describe how AI can, and should, be aligned to the Technological Knowledge, Pedagogical Knowledge, and Content Knowledge (TPACK) framework, as a part of special education teacher preparation. Additionally, we explore the implications of AI on the TPACK framework, specifically how AI can be integrated within each of the three components, specific tools that support each aspect, and guiding questions that teacher-educators and pre-service teachers should be using when considering AI. We will provide teacher-educators with example activities they can use with their pre-service teachers to introduce AI and integrate its use within their curriculum, framed within the TPACK.

KEYWORDS

Artificial intelligence, special education teacher preparation, TPACK

Dr. Williams exited another department meeting shaking her head. Beyond the typical policy and standards decisions that most gatherings included, talk about the dangers of artificial intelligence (AI) occupied a significant amount of her colleagues' discussions. Of course, she agreed that AI tools like ChatGPT and CoPilot were disruptive innovations and required departmental considerations; however, her efforts were focused not on preventing the use of these growing and ever-changing innovations, but on identifying ways to harness them in a meaningful way. While Dr. Williams did not consider herself a technologist, she understood that these tools played a role in preK-12 instruction and, thus, required her to stay on top of the innovations. Dr. Williams understood that if she did not infuse these technologies into her pre-service special education teacher preparation courses, then her undergraduate and graduate students might not be prepared to meaningfully implement these innovations into their preK-12 learning environments. The challenge was: How?

Artificial Intelligence (AI) is one of the most disruptive technologies in education, with the potential to shift how students with and without disabilities are taught and how general and special education teachers (SETs) are prepared (Marino et al., 2023). The introduction of generative AI (genAI; e.g., ChatGPT, Gemini, Claude) into education has led to conversations about what knowledge teachers still need and will need, as these AI have the potential to complete tasks previously reserved for humans (Marino et al., 2023). Simply teaching pre-service SETs how to use these existing, new, and emerging AIs for the sake of pushing technology into classrooms is not effective in supporting meaningful integration into instruction and improving student outcomes (Voithofer & Nelson, 2021). To bridge these technological advancements (specifically genAI) with student needs, pre-service SETs need explicit instruction as to how to use these technologies within their classroom instruction. Thus, pre-service SETs need to be strategically taught to use these and similar tools

TABLE 1: Types of AI

TYPE OF AI	DEFINITION	AI	
Prior to November 2022			
Adaptive Learning Platforms/ Intelligent Tutoring Systems	Systems that adapt to new data by learning, extracting patterns, and changing without human intervention	ALEKS Freckle	Khan Academy Lalilo
Natural Language Processors	Systems that read and respond to human stimuli in everyday language	Alexa Co:Writier Grammarly	Read&Write SIRI
After November 2022			
Generative Pre-Training Transformer	Systems that respond to questions using data on which they were previously trained	ChatGPT CoPilot Gemini	GrammarlyGo KhanMingo

Note. Definitions from Ruiz, P., & Fusco, J. (2024). *Glossary of artificial intelligence terms for educators.* Center for Integrative Research in Computer and Learning Sciences. https://circls.org/educatorcircls/ai-glossary

in isolation and integrate them into evidence-based pedagogy (Voithofer & Nelson, 2021).

Broadly, AI is a branch of computer science that creates "intelligence" from data and algorithms, allowing it to make decisions and find patterns (Ruiz & Fusco, 2024). Models of AI include (1) natural language processors, which can understand and comprehend language (e.g., Alexa, Siri; Ruiz & Fusco, 2024), and (2) adaptive learning platforms, which learn about and subsequently use these data on students' areas of strength and need to adapt instruction to meet their unique individual needs (e.g., ALEKS, Lalilo; see Table 1; Ruiz & Fusco, 2023). It is important to note that AI in classrooms is not new and has existed within classrooms and schools for decades (e.g., predictive text, attendance monitoring systems, and speech-to-text; Goldman, Taylor, et al., 2024; see Table 1). This includes learning management systems, large language model device features (e.g., Digital Assistants: Siri, Cortana, Google, word prediction, text-to-speech), and other features on common classroom devices such as Chromebooks, Apple iPads, and laptops. What is new to the classroom and the human experience is genAI such as ChatGPT, Gemini, and CoPilot. In November of 2022, Open AI released ChatGPT to the public, allowing widespread use of these large language models. What sets these new AI apart from the AI pre-November 2022 is the ability to create new knowledge without human intervention (Ruiz & Fusco, 2024). GenAI is trained on large datasets, which include all the publicly available data on the internet, and it can generate texts, images, and data based on prompts from the user. The various types of AI have been increasingly present in schools (Wang et al., 2024) as more and more districts invest in current and innovative technologies to support managing student data and leveraging it as a tool to support student learning. With increased access to technology and AI, teachers need a way to understand, integrate, and evaluate the use and effectiveness of the technology implementation.

At present, much of the energy appears to be focused on considering the ethical implications of genAI before widespread classroom implementation for student assignments. Fortunately, there are a number of state and local education efforts underway to develop recommendations for AI policies in syllabi including explaining why AI is required or prohibited, explicitly sharing examples and non-examples of appropriate use, and explaining how misuse will be addressed (Stanford, 2024). For example, the AI Assessment Scale is a tool developed by researchers to offer institutions of higher education a structured approach to AI usage (Perkins et al., 2024). This five-point scale assists faculty in providing higher education students, in this case, pre-service SETs, with explicit guidance as to the level of AI that can be used in their assignments, with 1 being no AI and 5 being full AI. Likewise, the Sante Fe Community College (see https://libraryhelp.sfcc.edu/Chat-GPT/syllabus-statements), like many colleges

TABLE 2: Sample Prompts

TOPIC	PROMPT
IEP Goal	You are an experienced special education teacher. Write a SMART math goal that targets adding three-digit numbers with regrouping. The goal should align to a 3rd grade math standard. Write the goal in a sentence that starts with Given ____, by next IEP date, student will. Include 3 objectives.
Reading Comprehension	You are a special education teacher trained in the Science of Reading. Write a 200-word passage for a 4th grader who decodes at the 2nd grade level. The passage should be about planets. Include 5 literal comprehension questions (who, what, when, where, how).
Math Problems	You are an experienced special education teacher who teaches 5th grade math. Your students have a goal for solving two step word problems. Generate 5 word problems about bakery items that I can use to assess their understanding.

and universities across the country, is curating lists of sample syllabus statements and course policies related to AI. With genAI continuing to develop, some argue it is still at its infancy, state departments of education, preK-12 school districts, colleges and universities, and similar entities will continue to grapple with the development of policies and practices to facilitate the appropriate use of these growing innovations. For the teacher educator, these foundational policies and procedures will only be the first step in a stepping stones approach we will be required to follow considering the ever-changing nature of genAI and the fact that AI is now part of our daily reality.

Accessing and Using GenAI

There are several options from which teacher educators and pre-service SETs can choose when considering integrating genAI into their practice. ChatGPT, Gemini, and Copilot are just a few of the genAI available with free options. While each platform has its strengths and drawbacks, they all serve the same basic function: generating prompt responses. For pre-service SETs to leverage genAI effectively, teacher educators need to teach prompt engineering. While there are many formulas to create an effective prompt, "AI for Education's Prompt Engineering Framework: The Five 'S' Model" is designed specifically for educators. According to the framework, effective prompting involves: (1) setting the scene, (2) being specific, (3) using simple language, (4) structuring the output, and (5) sharing feedback (AI for Education, 2023). See Table 2 for sample prompts.

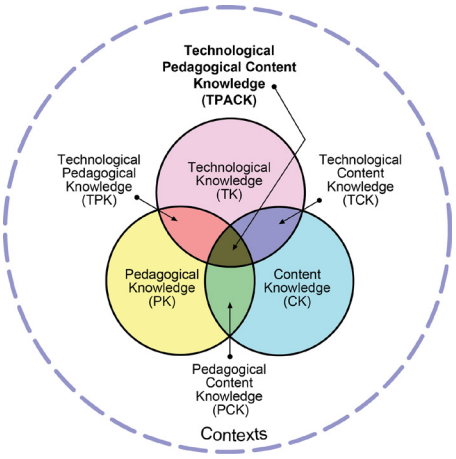
It felt like only yesterday that she began to appreciate what an effective AI prompt was and how important it was in getting one's desired output. Staying on top of this foundational skill kept her busy enough; it seemed every time she mentioned AI in class, a student shared another cool tool. There seemed to be countless opportunities to further the implementation of effective practices while enhancing inclusionary efforts and independence for students with disabilities.

As Dr. Williams returned to her office, she was reminded that the recent meeting focused on AI tools and ways to limit their use in teacher preparation coursework; but her role was to also promote student knowledge and skill growth. Her students needed to further their understanding of pedagogical and content knowledge. They needed to understand and be able to implement evidence-based practices and the growing high leverage practices that when integrated, would enhance inclusionary efforts and the overall learning outcomes of students with disabilities. Looking at the technology puzzle from this lens, she was reminded about a framework she had been introduced to nearly a decade ago when one-to-one digital devices were increasingly becoming the norm in the local preK-12 grade classrooms.

The TPACK Framework in Special Education Teacher Preparation

Providing opportunities for pre-service SETs to learn about the available and emerging technologies is important. And yet, simply teaching them the technology through how-to lessons is ineffective for long-term success (Voithofer & Nelson, 2021). Instead, teacher-educators need to prepare pre-service SETs to use these technologies, specifically genAI, through (1) direct instruction and modeling from the teacher-educator, (2) opportunities for pre-service SETs to use these technologies in their assignments and activities, and (3) opportunities for pre-service SETs to create lessons, assignments, and activities using these technologies and apply them to K-12 students, particularly those with disabilities (Farjon et al., 2019). However, efforts to align pre-service teacher education with similar recommendations

FIGURE 1: TPACK Framework



(Graziano et al., 2017) have often been challenging.

At the turn of the 21st century, for example, the United States government invested millions into the Preparing Tomorrow's Teachers to Use Technology initiatives. Grants were provided for over 100 institutions of higher education. The goal was to foster technology integration into teacher preparation (Polly et al., 2010). Over the past two decades with the explosion of digital learning (e.g., synchronous and asynchronous learning), the advancement in technology devices (e.g., iPad, handheld mobile devices), one-to-one technology device initiatives, and countless other technology-based learning programs, the need for to prepare classroom teachers to integrate these promising digital solutions has fostered several suggested strategies (Kopcha et al., 2020).

Before the COVID-19 pandemic, local schools were investing millions of dollars to equip all students with iPads and then Chromebooks. Google classroom and similar learning management systems were becoming the norm, and Dr. William's graduates were expected to enter their employment having a basic knowledge of the ever-changing technology-based tools. Similar to her recent reflections, she was faced with having to embrace some level of technology to ensure that her college students were being prepared for these technological expectations. At the time, the state education department shared information about the TPACK Framework (Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK)) (Mishra & Koehler, 2006; see Figure 1). *Dr. Williams recalled how the TPACK offered a means to address the growing technology tools without being required to become an expert in every app, learning management system, or even learning the basics of the various digital devices (e.g., iPad).*

TPACK and similar frameworks guide the integration of digital solutions (e.g., Gen-AI) into teacher development and support the subsequent application of this technology into the instructional, behavioral, and social-emotional development of the preK-12 learner; students with disabilities are often the primary beneficiary of such innovations. The TPACK framework, undergirded by the three named components, underscores the importance of using TK to support CK and PK and the importance of weaving them together in instruction effectively. With nearly 20 years of related research and over 1,200 journal articles (Mishra, 2019), the TPACK framework is a key component in preparing teachers to use technology effectively in their future classrooms (Irwanto, 2021). It also advocates for teacher candidates to have knowledge of and the integration of technology, content, and pedagogy (Foulger et al., 2019). Much of the research surrounding the framework has centered around K-12 education, but it is gaining traction in higher education (Graziano et al., 2017).

Each component has to be thought of in isolation (TK, PK, and CK separately) and considered in the overlap (e.g., TK+PK, TK+CK, TK+PK+CK), with the overall purpose being to find a way to integrate growing technologies that support education into classroom pedagogy and content effectively. Tools beyond computers, such as speech-to-text, interactive projectors (e.g., Epson Brightlink™, SMART board), and extended reality (i.e., virtual reality, augmented reality, mixed reality) would fit within the TK component. CK varies based on the grade level and type of teacher, as well as the standards and grade-level materials. For instance, CK for an elementary math teacher would include fractions, adding and subtracting with regrouping, and one-to-one correspondence. This differs from CK for a high school U.S. history teacher, which includes the Declaration of Independence and the events that led up to the Civil War. PK is the knowledge specific to teaching, such as differentiated instruction, flipped classrooms, and cooperative learning techniques. For example, the use of interactive graphic organizers to support written expression integrates TK (the interactive graphic organizer) with PK (the knowledge that students with disabilities benefit from graphic organizers to support their writing), and CK (the overall focus on written expression). And, while AI is technically considered an emerging technology, its capabilities and promises go beyond the TK component of the framework and influence the PK and CK components of the TPACK, as well.

The TPACK allowed her to include growing innovations within her knowledge and expertise in pedagogical and content instruction. As she opened her laptop, she promised herself to review the basics of the TPACK and to once again look to this framework as a means to harness an innovation, in this case, AI, to support her college students and, in turn, support their ability to understand and use the promising features of AI with preK-12 students with disabilities.

AI has the potential to transcend all

TABLE 3: TPACK and AI Alignment

Category	Definition	Rationale	Specific AI Tools	Guiding Questions/ Specific Queries
Technology Knowledge	Knowledge of specific technology	Pre-service SETs need to be taught to find resources for themselves On-demand tech support	There's an AI for That AI Tool Report AIEducator.Tools ChatGPT Gemini Perplexity	What are you looking for the AI to do? If you were to describe your problem to the IT person, what would you say?
Pedagogy Knowledge	Knowledge of instructional approaches	A need to personalize learning to improve student outcomes Pre-service SETs should not be expected to be experts in everything	Magic School AI Ludia UDL AI Teachology.AI Plainitteachers.ai ToTeach.AI	I'm having difficulty with ____, what can I do to improve? Can you operationalize ___ for me? How do I teach…
Content Knowledge	Knowledge of specific subjects	Increasing in co-teaching where Pre-service SETs may not have content knowledge expertise Pre-service SETs should not be expected to be experts in everything	Read Trellis Albert Bro TutorAI	Can you explain ___ to me? What happened in chapter 4 of ____? Here's the math problem I'm struggling with…

the components of the TPACK framework (Mishra et al., 2023). Thus, this article describes how AI can and should be an integrated topic within SET preparation. We describe how AI can and should be integrated within the three components of the TPACK framework as a part of SET preparation. With the weekly, if not daily, advances in AI classroom, teachers need the knowledge and skills to integrate these ever-advancing tools meaningfully into instructional interventions to improve learner outcomes further.

AI and its Alignment to the TPACK Framework

Effective integration of AI into pre-service teacher preparation curricula includes (1) direct instruction and modeling by teacher-educators, (2) opportunities for pre-service SETs to practice using AI in their assignments, and in-class activities, and (3) having pre-service teachers create lessons, assignments, and activities with AI and that leverage AI for use with K-12 students. Therefore, we propose that AI should be considered in each component of the framework (AI+TK, AI+PK, AI+CK), in the intersection (AI+TK+PK, AI+TK+CK), and fully encompasses the framework (AI*TPACK; Irwanto, 2021) for teachers and students to reap its benefits fully. In this article, we explore the alignment implications of AI on the TPACK framework, specifically how AI can be integrated within each of the three components, examples of tools that support each aspect, and guiding questions that teacher-educators and pre-service SETs should consider when using AI. We will provide teacher-educators with sample activities they can use with their pre-service SETs to introduce AI and effectively integrate it within their curriculum, framed within the TPACK.

While the discussion around the importance of integrating the TPACK framework into SET preparation (e.g., Anderson & Putman, 2023; Anderson & Putnam, 2020) is not novel, what is new is the consideration of how AI fits within, or as we suggest in this article, fully encompasses the framework. Researchers are beginning to conceptualize and integrate AI into the TPACK framework and are looking to alter or expand the framework in light of this disruptive technology (e.g., Celik, 2023; Mishra et al., 2023; Ning et al., 2024). To that end, in the following sections, we detail how

faculty in pre-service special educator preparation programs can begin to integrate and align AI to the TPACK framework (see Table 3).

Technology Knowledge (TK) and AI

Defining what TK is can be challenging, according to the TPACK authors Koehler and Mishra (2009), due to the fact that technology is always changing. The term technology encompasses everything from a pencil to an iPad and everything in between and beyond. Educational technology, a broad category encompassing all technologies students use in the classroom (Mao et al., 2019), can be further categorized into instructional technologies and assistive technologies. Instructional technologies, as described by Howorth & Kennedy (2021), encompass tools used within the learning environment, such as websites, game-based learning platforms, and mobile device carts (e.g., iPads or Chromebooks). Assistive technologies, on the other hand, are specialized tools that support students with disabilities in accessing and engaging with the curriculum (US Department of Education, 2024). These can include adaptive switches, augmented and alternative communication devices, text-to-speech software, and word prediction software. Beyond defining technology, effective TK includes an understanding that technology has inherent biases, constraints, and potentials and impacts how and when it should be used (Koehler & Mishra, 2009). The recent National Educational Technology Plan (2024) suggests that TK should include an understanding of how technology can enhance learning and design learning experiences. Additionally, it includes the knowledge and ability to advocate for equity in access and content.

Research suggests that pre-service SETs are more likely to develop competencies in the area of TK in stand-alone technology courses and/or from faculty with expertise in the technology field (Foulger et al., 2019). While it may not be feasible or even possible for pre-service programs to encompass TK fully, they must prepare future teachers to seek TK independently. Examples include providing them with resources to find technologies that support their instruction and positively impact their students' outcomes (i.e., Edutopia's Technology Integration section or There's an AI for That) and staying up-to-date on technology policy and best practices (e.g., the U.S. Department of Education's Office of Educational Technology or Common Sense Media).

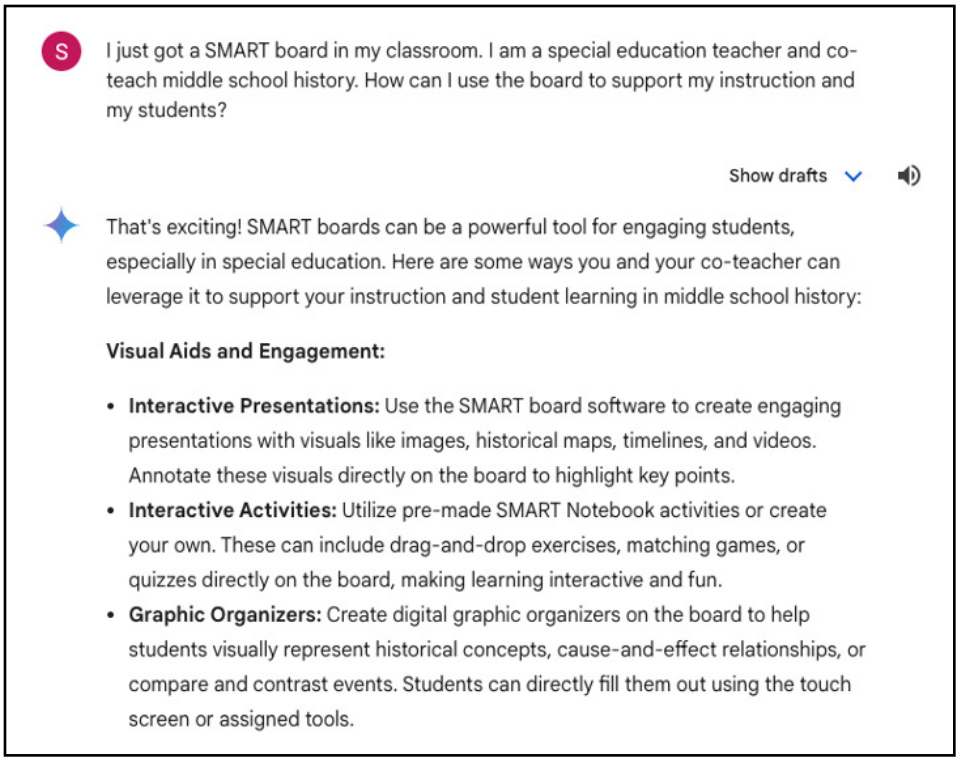
As classrooms continue to explode with new technology, pre-service teacher preparation programs are not able to provide training to in-service teachers who are also seeing an increase of technology in their classrooms. Therefore, just as SETs need training as to how to integrate innovations into their classrooms, so do in-service teachers. While the investment into acquiring more classroom computing devices has provided teachers with the opportunity to personalize learning and further integrate digital literacy into their classrooms (US Department of Education, 2024), without effective professional development and training in the integration of such technologies, teachers are left to learn on their own or, in some cases, underutilize the technology they have.

Though SETs are experts in their fields, they may not consider themselves TK experts (Anderson & Putman, 2020). Research supports that frequently, teachers learn about new ways to utilize classroom technologies from other teachers (Winter et al., 2021). Another way for teachers to consider new and innovative ways of using the available and emerging technologies in their classrooms is through collaboration with genAI. As shown in Figure 2, genAI can provide several suggestions for further technology integration in their classroom. To do this, teachers can use a simple prompt that explains the technology they are looking to integrate and the subject and context in which they teach. For instance, SETs ask genAI for examples of ways to use a classroom set of iPads to support addition fact fluency for second graders with and without disabilities. Or, SETs can ask how to leverage wearable virtual reality headsets (i.e., the Oculus) to help middle school students with social skills deficits.

Additionally, it is important to consider that when using technology, things inevitably go wrong, making TK and troubleshooting knowledge necessary (Anderson & Putman, 2020). In a recent study, pre-service SETs identified one challenge with technology integration is that technology does not always work as planned (Valtonen et al., 2020). Teachers must sometimes make troubleshooting decisions within a split second before their class becomes impatient and disorder ensues. Current options include pivoting to a different activity, which might be disappointing for some and is an added rocky transition, or calling the school or district IT for support and hoping they can help. Both options are not ideal and present a bevy of challenges for teachers, including lost instructional time, difficult transition, and elevated student behaviors due to interruption and disruptions to typical routines.

While AI cannot replace professional development and teacher-to-teacher collaboration, AI can provide teachers with on-demand tech support and troubleshooting. Simply using ChatGPT or another genAI application, teachers can get tips, tricks, and step-by-step guides to get their tech-forward classrooms back up and running. While the AI chatbot may not be able to troubleshoot and solve every problem that arises with classroom technology, it can provide the

FIGURE 2: Using Generative AI to Integrate Technology into Instruction



first level of consultation and possibly save the teacher's lesson. For a sample troubleshooting output produced by Gemini about how to fix a projector that is not working, see Figure 3.

In isolation, it is important to understand how to leverage genAI best. As a new technology, users need to learn the nuances required to prompt or ask questions to get the desired outputs. Often, users will need to ask a question several times in different ways, before the genAI provides them with the exact response they were hoping for. While prompt practice is becoming a popular area of professional development related to AI (see https://www.codecademy.com/ or https://www.aiforeducation.io/), using it in isolation is ineffective at meaningfully integrating AI into curricula.

Content Knowledge (CK) and AI

CK can be defined as math, science, reading, writing, or any other area addressed by the curriculum (Mishra & Koehler, 2006). Content knowledge is fundamental within special education, and teachers are expected to be experts in several content areas. One SET may support students in their Algebra 1, U.S. History, and Biology courses. This means that special education students must understand the course material, including central facts, procedures, and rules of evidence (Mishra & Koehler, 2006).

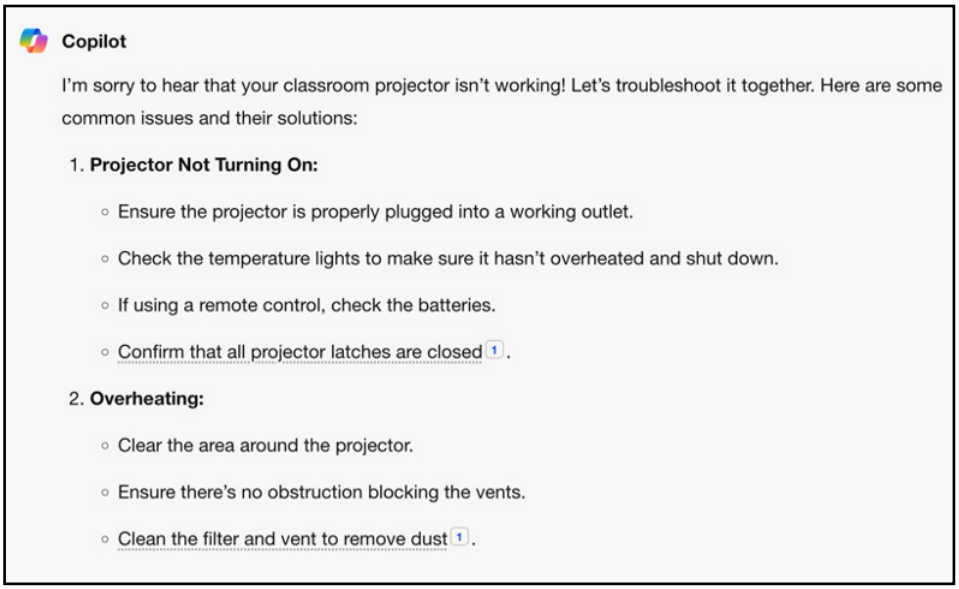
Being an expert in all subjects is nearly impossible. Several AIs support the CK (Goldman, Taylor, et al., 2024). GenAI can generate novels at differentiated reading levels, answer comprehension questions, and identify key vocabulary (Goldman et al., in press). For example, the reading level of the popular upper elementary school novel *Wonder* by R.J. Palacio may be too complex for struggling readers. SETs can prompt genAI to produce an abridged version of the text at particular grade levels to remove barriers. With AlbertBro, a math AI, SETs can upload images of math problems and receive step-by-step instructions on how to solve them.

While meaningful integration of genAI is the ultimate goal, it is also imperative for SETs to understand the CK of genAI. This includes topics such as AI literacy and prompt engineering. AI literacy is defined as the knowledge and skills necessary to critically use, understand, and evaluate AI tools and systems in order to use them safely and ethically (Mills et al., 2024). An important aspect of AI literacy is an understanding that SETs should not take legal, ethical, or compliance advice from the AI. While the AI can provide overarching guidance, it remains the teacher's responsibility to ensure the information is correct through more traditional search methods. Examples of this include checking the references and websites the AI cites and cross checking the information provided by one AI with other genAIs for agreement. To learn more about AI literacy, SETs can visit Digital Promise (DigitalPromise.org) or Common Sense Education (CommonSense.org).

Prompt engineering refers to the skillset required to obtain high-quality outputs from interactions with genAI (Knoth et al., 2024). While the process of prompting can sometimes involve trial and error (Knoth et al., 2024), employing prompt engineering frameworks, such as those developed by AI for Education (see https://www.aiforeducation.io/), can enhance the likelihood that the genAI's responses align with the SETs request. According to AI for Education, high-quality prompts should provide context (e.g., "you are a special education teacher" or " you are a 3rd grade student"), be specific (what do you want it to do), use simple language (avoid jargon), provide the requested structure (e.g., paragraph, bullet points), and provide feedback (e.g., tell the genAI what you want it to change).

Beyond its use in preK-12 education, genAI can support pre-service SETs

FIGURE 3: Using GenAI to Troubleshoot Technology



with the required content of being a SET. SETs are expected to be experts in the Individuals with Disabilities Education Act (IDEA, 2004), policies and procedures related to Individual Education Programs (IEPs), informal and formal academic assessments, and aligning areas of need to evidence-based practices and interventions. The expectation of special education CK is astronomical for a seasoned SET, let alone a novice one.

Several AIs exist to support SETs with special education CK. A Platform for Open Education (Poe; see https://poe.com/), has numerous AI trained to complete specific tasks.For example, WritingIEPgoals assistant (see https://poe.com/WritingIEPgoals) is an expert at developing personalized goals to support student learning. Another example is the SPEDTeacher (see https://poe.com/SPEDTeacher), which is an expert at guiding families through the IEP or 504 process. Both tools allow teachers to break down parts of the IEP and classroom materials to reduce time and create a more positive environment.

Pedagogical Knowledge (PK) and AI

PK is the understanding of instructional supports, techniques, and strategies (Mishra & Koehler, 2006). Where CK is understanding *what* you are teaching, PK is understanding *how* to teach it. This includes having strong classroom management skills, an understanding of child development, and a repertoire of tools and strategies that can be applied to a variety of situations and lessons (Shulman, 2013). More specifically, this includes SETs having an understanding of proximity, modeling, and assessment. Pre-service teachers report the most confidence in PK, specifically related to their abilities to motivate their students and engage them in activities, and report challenges with managing lessons and time management (Valtonen et al., 2020).

PK includes an understanding that student learning outcomes are improved when lessons are designed for the variability within their classrooms rather than a one-size-fits-all approach (Smith et al., 2019). Several AI supports can help teachers personalize learning, add interactively to their lessons, and support the variety of learners in the classroom. One example that is gaining a lot of traction amongst K-12 teachers is MagicSchool.ai (see https://app.magicschool.ai/). This AI supports teachers in creating choice boards, differentiating assignments to support the variety of learners by summarizing and leveling text, and providing support in giving targeted feedback to students. Magicschool.ai is a free website for teachers to streamline their workload and their ability to understand and implement successful pedagogy. Another great resource is Diffit (see https://web.diffit.me/), which differentiates curricula to create individualized and target resources. Examples of some of the tools within Diffit include the creation of differentiated activities, designing graphic organizers that align with lesson targets, and adapting articles to student reading levels.

Integrating AI and the TPACK Framework into Special Education Teacher Preparation

While each area of the TPACK framework has merit and benefits from the AI supercharge, it is when the various components of the framework interact that teachers and students truly benefit. Research suggests that pre-service teacher preparation should work to make the various aspects of the TPACK framework concrete so that SETs can experience and reflect on the framework and its application in their future teaching (Valtonen et al., 2020). Below, we detail considerations for SET preparation faculty when bringing AI into courses and offer suggestions for assignments faculty can use in their curricula (see Table 4).

Examples of Integrating Technology Knowledge (TK), Content Knowledge (CK), and AI

One key aspect of SET preparation classes is learning the core principles of IDEA (Clausen et al., 2023) and how they manifest within the IEP and IEP meetings. Future SETs must be prepared to respond when the principles of IDEA are not being followed. One suggestion for helping them with this task is to evaluate vignettes (Cheatham et al., 2012).

FIGURE 4: Screenshots of Vignette Assignment with Copilot

Scenario:

Name: Emily

Background: Emily is a 10-year-old student with autism spectrum disorder (ASD). She has difficulty with social interactions, sensory sensitivities, and transitions.

School Situation: Emily attends a public elementary school. Her parents have requested an Individualized Education Program (IEP) meeting to discuss her needs and accommodations.

Violation of "Zero Reject": The school denies Emily's parents' request for an IEP meeting, claiming that her needs are not severe enough to warrant special education services. They argue that Emily can manage in a regular classroom without additional support.

Consequences: By denying Emily's parents' request, the school violates the "zero reject" principle. Emily's right to FAPE is compromised, as she is not receiving the individualized support necessary for her educational success. This situation could lead to academic struggles, social isolation, and emotional distress for Emily.

Remember that this scenario is fictional, but it illustrates how a violation of the "zero reject" principle could occur. In reality, schools should provide appropriate services to all eligible students with disabilities, regardless of the severity of their needs.

One way to do this is to give vignettes with critical errors to pre-service SETs and have them identify the violated principle, supporting their thinking by citing evidence from the vignette and then providing alternative solutions to the issues. This method assumes that pre-service SETs have the confidence and special education-specific knowledge (e.g., understanding of the law) to determine the errors in the vignette and the experience and knowledge to make necessary recommendations to improve it.

Instead, consider having pre-service SETs use genAI to determine the error in the vignette and suggest strategies and interventions to support better outcomes. First, pre-service SETs can generate their own scenarios using AI. Examples of prompts include: "Generate a scenario that violates one of the six principles of IDEA, but don't tell me which principle" or "Generate a scenario that violates the 'zero reject' principle of IDEA". See Figure 4 for a sample of this interaction.

Next, have pre-service SETs switch vignettes with others in the class. After, have them identify the principles that were violated in the vignette. To do this, students can feed the vignette into the AI and use prompts such as "Which IDEA principle does this violate and why". With the explanation provided by the AI, instruct them to identify the sentence(s) that point to the violation by highlighting the sentence in the vignette and indicating which of the six principles it violates. Finally, pre-service SETs can work in tandem with the AI to generate suggestions and/or solutions to combat these violations through prompts such as "Give me suggestions of what I could do instead" or "What is a better way to handle this situation". Remind pre-service SETs that they are the ultimate experts and, while the AI can offer supports and suggestions, it does not know their individual students or situations. After interacting with the AI, have pre-service SETs re-write the scenario so that it does not violate the principle. Figure 5 shows this activity.

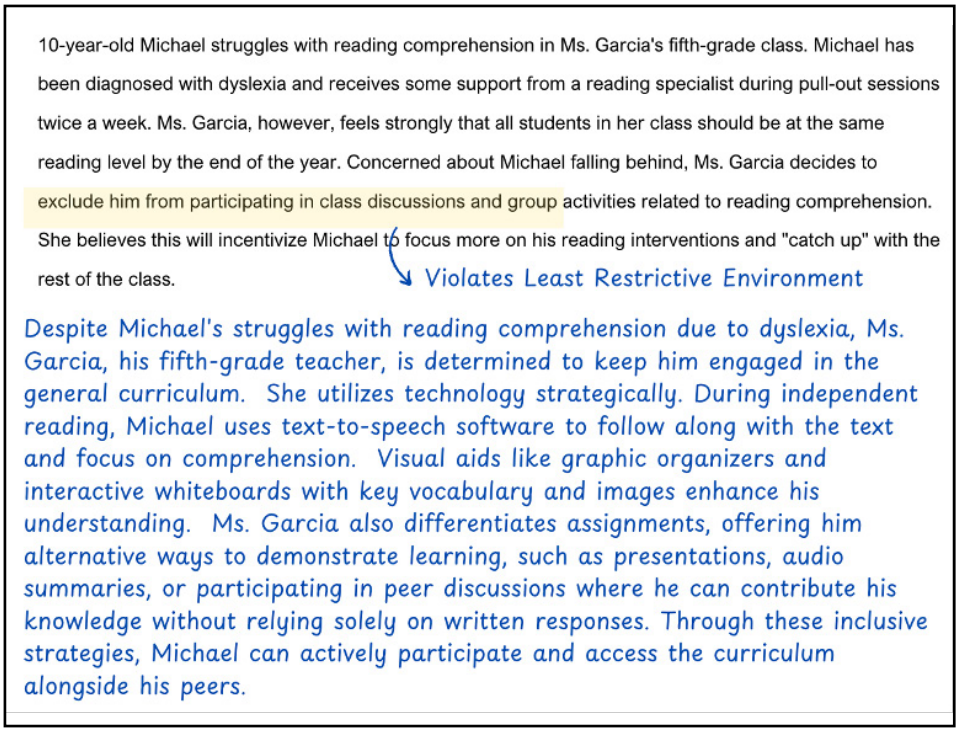
Examples of Integrating Technology Knowledge (TK), Pedagogical Knowledge (PK), and AI

Another common project within SET preparation courses is having pre-service SETs understand the categories of disability under IDEA by researching a disability and creating handout that details important aspects of that disability, with a focus on strategies to support students in the general education classroom. In this original assignment, students researched their disability category using the internet, journals, books, and the library.

In the age of genAI, it is important to consider how pre-service SETs can leverage this technology to learn about the various disability categories and ways to best support the variability in classrooms. Pre-service SETs should be encouraged to embrace genAI to access resources about the various disability groups quickly. A recent study comparing traditional and ChatGPT-generated handouts found no statistically significant difference in responses (Goldman, Smith, and Peyton, in preparation). Thus, using ChatGPT to generate this content proves to be an accurate means of obtaining the information and saves time. Other AI models, like Copilot, include citations to back up their responses. Educators can use this AI guidance as a starting point and explore the cited websites and articles to deepen their understanding and ensure accuracy. As mentioned earlier, SETs should not use genAI as their sole source for legal, compliance, or ethical advice. SETs can also leverage more specialized AI tools that offer greater control over the source and curation of information. For example, School AI (see https://schoolai.com/) has specialized assistants that pre-services SETs can use to learn more about disability categories.

Prompts for it to create the necessary information for the handouts include: (1) "Explain the characteristics of (insert disability category)", (2) "What supports might a student with (insert disability category) need to be successful in the general education classroom?", (3) "What strategies can I, as the teacher, use to further support a student with (insert disability category)?", or (4)

FIGURE 5: Sample Vignette Assignment



"What are some strengths of students with (insert disability category)". To further integrate TK and PK, pre-service SETs can use prompts such as "What educational or assistive technologies might a student with (insert disability category) benefit from?" or "How can I use technology to support students with (insert disability category)".

Examples of Integrating TK, PK, CK, and AI

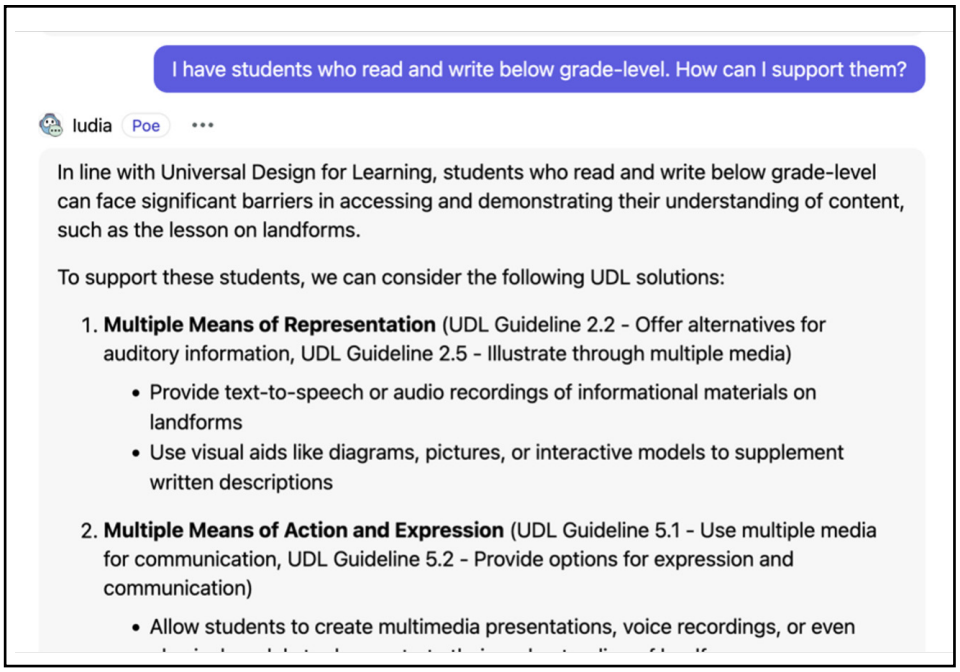
A culminating experience in many special education preparation courses is developing a Universal Design for Learning (UDL)- aligned lesson plan. The UDL framework (Rose, 2000) has teachers consider the variability within their classrooms through multiple means of representation, engagement, and action/expression (Smith et al., 2019). Rather than designing a lesson and then adapting it to meet the needs of the various learners in the classroom (e.g., those with disabilities, English Language Learners, gifted learners, etc.), UDL encourages teachers to design for variability from the onset to reduce barriers to learning (Smith et al., 2019). This assignment integrates all aspects of the TPACK framework as pre-service SETs are asked to integrate their PK and CK of the curriculum and students with disabilities. Additionally, pre-service SETs are encouraged to leverage their TK and include resources that support student learning outcomes. They are asked to create a lesson plan that embraces the UDL framework, accounting for the unique needs of an identified case study student, while considering the unique and diverse classroom needs. While the experience of designing and implementing a UDL-aligned lesson is valuable, there are several barriers pre-service SETs face with this assignment including (1) only a surface-level understanding of the overall framework, (2) minimal understanding of the scope and sequence of the curriculum, (3) a novice understanding of pedagogy and strategies to support student outcomes, and (4) an inability to integrate these concepts to create a cohesive lesson plan. The purpose of this activity is not to master designing a lesson plan, but rather to show mastery of applying the UDL framework to their content area. Using AI, teacher educators can work with their pre-service SETs to overcome these barriers and design lessons that improve student learning outcomes.

Creating engaging, accurate, and complete lesson plans is often a tedious and stressful task for pre-service and novice teachers. However, several AI lesson plan supports currently exist. First, pre-service SETs can use ChatGPT, or other genAI chatbots, to craft their lessons. Prompts include "Design a UDL-aligned lesson plan for 2nd graders working on adding and subtracting with regrouping" or "What are some ideas to address multiple means of representation in a 4th-grade reading comprehension activity?"

Another option is using LUDIA (see https://poe.com/Iudia), an AI designed to integrate the UDL framework into its responses. Pre-service SETs can use prompts such as "I am creating a lesson for 3rd graders about landforms". LUDIA's embedded instructions ask users to include relevant information such as student language profiles, interests, strengths, and cultural identities. Figure 6 shows a sample chat with LUDIA where a pre-service teacher is working in tandem with the AI to develop a lesson plan on landforms. As the goal of the activity is to integrate their understanding of UDL into their desired content area, creating a standard lesson plan is one option for expressing their knowledge.

Another method would be to provide students with an empty UDL framework to fill in with the co-created lesson pieces developed with LUDIA. See Figure 7 for a sample. Additionally, teachers can use resources within Magic School (see https://app.magicschool.ai/) to find AI-based tools that support the ideas

FIGURE 6: Sample LUDIA Chat



generated from LUDIA or ChatGPT. For instance, Magic School has a choice board creator and text-leveler, which are essential when considering multiple means of representation, engagement, and action/ expression. Throughout this assignment, pre-service SETs work through an iterative process of prompting the AI to generate ideas, using their thoughts on the topic, other relevant information from the course, and their experiences in the teacher preparation program. The use of AI allows pre-service SETs to refine their skills in designing lesson plans with personalized support.

Implications

To adequately support students with disabilities, teacher preparation programs need to intentionally prepare pre-service teachers to utilize technological innovations, such as genAI (Dawson et al., 2019). The innovation of AI, particularly genAI, represents a technological shift that can impact all aspects of education. However, as AI technology improves preparation programs, they must consider integrating AI meaningfully into the teacher preparation curriculum. To fully harness genAI, SETs need to conceptualize it within the context of the TPACK framework. This involves identifying its functions within the three components and understanding how its abilities can co-exist in those components. With this knowledge and increased access to tools, the potential of AI's continued growth and impact on education is infinite.

By integrating AI, teacher preparation programs can build and enhance the capacity of their SETs to better prepare them for a future teaching career that blends traditional teaching methods with technology. Moreover, increased efficiency in lesson planning and content creation can save time and frustration, as well as provide lessons that work to ensure improved outcomes for all learners. These examples represent just a snapshot of what genAI can offer the teaching profession, particularly SETs, if integrated meaningfully and effectively.

With all these wonderful opportunities for SETs, it becomes imperative to ensure teacher preparation programs integrate AI, TK, CK, and PK into the curriculum to harness its potential impact on the teaching profession fully. SET preparation curriculum and faculty must align CK and PK coursework with the TPACK framework and model how AI can be used. This means creating direct experiences with AI and embedding practical application opportunities. Further, faculty must collaborate on the integration of AI to ensure that faculty and pre-service SETs are not just getting "prompt" practice, but are given the opportunity to manipulate and interact with a variety of useful AI tools. In short, student learning needs to go beyond asking a genAI a question to learn how to integrate AI into the curriculum fully.

CONCLUSION

As the integration of AI continues to permeate the education environment, the need to align the use of the technology with a research-based framework like TPACK emerges as critical. The three components of TPACK are long-recognized (Mishra & Koehler, 2006) and provide ideal alignment to the features and opportunities afforded by AI. Leveraging genAI tools, such as ChatGPT, CoPilot, Gemini, and others, provides SETs unprecedented access to tools that provide on-demand support, instantaneous feedback, and the ability to create and differentiate instructional activities and opportunities. With this new and increased access, AI can enhance classroom practices, learning, and interaction while empowering educators to address the diverse and unique learning needs of all students more effectively. As SETs navigate this intersection of AI and teacher practice, it becomes clear that more training is needed at the SET preparation level to keep up with the ever-changing educational technology landscape.

Aligning AI integration and the

FIGURE 7: Example of UDL and LUDIA Worksheet Representation Column

Provide Multiple Means of Representation
Provide options for **Perception** - Provide text-to-speech or audio recordings of informational materials on landforms - Use visual aids like diagrams, pictures, or interactive models to supplement written descriptions
Provide options for **Language & Symbols**
Provide options for **Comprehension** Jigsaw Activity: - Divide the class into "expert" groups, each responsible for learning about a specific type of landform. - Within the expert groups, have students work together to research the landform and prepare a short lesson to teach the rest of the class. - Then, reorganize the students into "learning" groups, where each member brings their expertise on a different landform to share with the group. - This structure encourages students to actively listen, take notes, and learn from one another in a more accessible format.
Resourceful & Knowledgeable

TPACK framework is ideal for addressing integration for pre-service special education faculty. Pre-service faculty could strategically align TK, CK, and PK with AI technology to enhance the educational experiences of their future SETs. By providing experiential activities such as crafting UDL-aligned lessons, changing text complexity, and personalizing activities based on student profiles using AI, pre-service SETs can deepen their understanding of the tools and cultivate the capacity to glean the full realm of what AI has to offer. Further, by acknowledging the critical relationship between the pre-service SET user and the AI, preparation programs can instill skills such as adaptability, collaboration, and continuous professional development in their SETs. Therefore, as we continue down the path of AI integration, SET preparation programs must embrace the expertise of their pre-service SETs and the pivotal role AI will continue to play in the success of their future students and classrooms.

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