

Using an Artificial Intelligence (AI) Agent to Support Teacher Instruction and Student Learning

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ABSTRACT

The options for Artificial intelligence (AI) tools used in teacher education are increasing daily, but more is only sometimes better for teachers working in already complex classroom settings. This team discusses the increase of AI in schools and provides an example from administrators, teacher educators, and computer scientists of an AI virtual agent and the research to support student learning and teachers in classroom settings. The authors discuss the creation and potential of virtual characters in elementary classrooms, combined with biometrics and facial emotional recognition, which in this study has impacted student learning and offered support to the teacher. The researchers share the development of the AI agent, the lessons learned, the integration of biometrics and facial tracking, and how teachers use this emerging form of AI both in classroom-based center activities and to support students' emotional regulation. The authors conclude by describing the application of this type of support in teacher preparation programs and a vision of the future of using AI agents in instruction.

KEYWORDS

Artificial intelligence, biometric, computer science, disability, special education, teacher education

As Artificial intelligence (AI) technology advances, researchers are increasingly adopting these new methodologies, particularly in student learning systems, which is leading to the development of automated adaptive learning as a standard feature in intelligent tutoring systems. An AI or intelligent agent is a software entity that perceives its environment and takes actions to achieve specific goals. These agents operate autonomously, making decisions based on data and predefined programmed algorithms. They utilize AI techniques to interact with the environment. The benefit of an AI agent in the classroom is its autonomy in taking action without the support of humans. An important aspect when preparing teachers to use AI agents is the social capacity of students to bond with the agent and the potential bias built into the system being used (Castelfranchi, 1998). Yet other researchers argue that AI-powered agents provide options to help make online learning and learning cost-efficient while increasing learning gains (Goel, 2020). Some recent researchers suggest a future where not only will students be supported by AI agents, but AI agents will serve as potential team teachers to help augment areas of content or instructional needs (Lan & Chen, 2024).

Dai and Ke (2022) highlighted the emergence of virtual agents powered by AI, benefiting from advancements in natural language processing and generative AI, as a significant trend in educational applications. These AI agents are evolving to become more convincing and expressive, capable of responding to student emotions with advances in multimodal data collection, recognition algorithms, and signal processing. Studies by Baker et al. (2008), Nakano and Ishii (2010), Prepin et al. (2012), and Yu et al. (2013) have explored automating positive relationship detection by analyzing conversational behaviors. However, most of these studies are either at the higher education level or fail to include neurodiverse students in their testing populations

In this article, we describe the application of AI agent support in teacher preparation programs and a vision of the future of using AI agents in instruction.

and training data (Memarian & Doleck, 2024). While there is broad research support for the effectiveness of affective virtual agents supporting student motivation and self-efficacy (Dai et al., 2024; Guo & Goh, 2015), research supporting the generalization of affect measurement techniques and virtual agent design for neurodiverse students is rare.

Integrating AI agents into educational settings has garnered significant attention recently (Barz et al., 2024), particularly in enhancing teaching methodologies and student engagement. AI agents can provide virtual representations of users while offering a unique avenue for interaction and learning in digital environments. The use of AI agents in the classroom has been explored across various studies (Dai et al., 2024; Jeon, 2022), highlighting its potential to create immersive and interactive learning experiences.

The effectiveness of AI agents in education is further supported by the work of Schroeder and Axelsson (2006), who examined the impact of AI agents on social presence in virtual learning environments; a more recent study found positive use in heart patients' self-care in the field of nursing (Wonggom et al., 2020). Charlton and colleagues (2020) noted the impact on social initiation for students identified with Autism spectrum disorder (ASD). Their findings suggest that AI agents can facilitate a sense of community and belonging among students, a crucial aspect of effective learning. As facilitated by teacher AI agents, this sense of presence can bridge the gap between traditional and digital learning

spaces, making education engaging and accessible.

Moreover, AI agents' adaptability provides a personalized learning experience catering to students' diverse needs. With further advances in multimodal data collection, recognition algorithms, and signal processing, these AI agents are becoming more convincing, expressive, and responsive to student emotions. Previous research has found ways to automate positive relationship detection through the collection and analysis of conversational behaviors such as verbal turn-taking, body posture, facial expression, and eye gaze behavior (Baker et al., 2008; Nakano & Ishii, 2010; Prepin et al., 2012; Skantze, 2021; Yu et al., 2013). Anagnostopoulou et al. (2020) explored the customization of teacher AI agents and its impact on student motivation and engagement. The study found that personalized AI agents could cater to individual learning preferences, enhancing the educational experience. This personalization aspect of AI agents signifies a shift towards more student-centered learning approaches, where the educational content and delivery methods are tailored to meet the unique needs of each learner.

Considering the specific area of social and communication skills development for students with ASD, initial efforts suggest emerging facial recognition technology can be used effectively to help students identify and learn discrete facial expressions (Garcia-Garcia et al., 2022; Ali et al., 2023). Further, using a social virtual agent can increase student initiation of conversation (Li et

al., 2023). Yet, most of these systems focus on direct training of facial emotion recognition without the complexities of participating in a responsive social dialogue (Garcia-Garcia et al., 2022; Harrold et al., 2014). Examining the role of AI virtual agents in more natural social interactions remains an emerging area of study.

AI Agent Implementation by Teachers

Although AI tools hold promise for teachers, their implementation is not without challenges. Technical issues, such as the requirement for robust digital infrastructure and the risk of reduced human interaction, create barriers to widespread classroom adoption. Educators need to prioritize reliable technology and balance virtual and human interactions when integrating AI agents into their teaching practices.

Teachers' use of AI agents in the classroom presents a promising avenue for enhancing educational experiences. The literature suggests AI agents can significantly improve student engagement, foster a sense of community, and provide personalized learning experiences. However, successfully integrating AI agents into educational settings requires careful consideration of technical and interpersonal challenges.

The authors provide a summary of an ongoing research study being implemented in four elementary schools attempting to create a teacher-driven AI-agent model for working with students to learn coding while supporting students in self-regulation (specifically on-task behavior), positive interactions, and communication skills during math class. The research team shares an overview of the study, a vignette, and steps for using AI agents in the classroom. The team then shares the struggles and pitfalls of using AI agents as well as considerations for teachers working to integrate personalized AI tools into classroom settings.

FIGURE 1: Implementation Steps for Consideration of using an AI Agent in the Classroom

When implementing an AI agent effectively in the classroom to support student learning and on-task behavior, teachers can follow these guidelines:

Purpose and Scope:

- Understand the specific purpose of using an AI agent in the classroom. The AI agent should enhance student engagement, provide personalized assistance, and promote positive behavior.
- Ensure that the AI agent aligns with the educational goals of the classroom and complements existing teaching methods.

Guiding Principles for AI Agent use:

- Use the AI agent to address individual student needs, such as providing additional explanations, answering questions, providing affirming statements, or offering study tips.
- Leverage the AI agent to encourage positive behavior, reinforce on-task actions, and provide timely feedback.
- Ensure the AI agent adheres to student privacy regulations and maintains a safe online environment.
- Communicate the AI agent's role, capabilities, and limitations to students, fostering trust and understanding.

Ensure Teacher-Student Collaboration:

- Introduce the AI agent to students, explaining its purpose and how it will assist them.
- Encourage students to provide feedback on their interactions with the AI agent. Adjust its behavior based on student input.
- Monitor student interactions with the AI agent to identify any issues or challenges.
- Intervene when necessary to ensure a positive experience.

Remember, the purpose of using an AI agent is to enhance the learning environment, promote student engagement, and contribute to a supportive classroom atmosphere.

Study Overview

Project RAISE represents a collaboration led by UCP of Central Florida in collaboration with the University of Central Florida and the University of Kansas. UCP of Central Florida is a nonprofit organization and is a network of inclusive public charter schools. The U.S. Department of Education Office of Special Education Program (OSEP) funds the project through a Stepping UP Grant. Project RAISE aims to improve the social skills of students with disabilities (SWD) by creating an AI-driven socially assistive character, ZB™ in K-5 classrooms and an online robot, Ray-Z, that teaches basic coding skills. At its core, Project RAISE aims to improve communication skills and time on task for SWD while enhancing these students' educational experiences by focusing on coding, science, technology, engineering, and mathematics (STEM) content.

Central to this initiative was the development of ZB™, an AI agent type designed to support SWD in acquiring so-

cial skills and fundamental coding skills. The AI agent, ZB™, supports students through three study phases. These range from learning basic coding from ZB™ to coding with a peer and having ZB™ in the classroom to support on-task and communication skills. Implementation of ZB™ initially occurred using multiple setups of an iPad, programming a physical robot using Blockly, and a teddy-bear-like AI agent that was initially controlled by a human-in-the-loop. The student also wore a biometric device to help trigger the changing colors of the heart and face of the AI agent to mirror that of the participant. Using iterative development cycles of the AI agent, the team made several changes based on teacher feedback. These changes are aligned with supporting new teachers in preparing for this changing world of using AI agents in the classroom.

As the project evolved and the AI agent became automated, the following vignette shows how such an agent is used in classrooms:

A teacher, Mr. Aiden, wants to use an

AI agent to help students learn coding. First, he decides to see if his students who might struggle in working with peers could learn to code a simple square with an online robot and an AI agent coaching the student. After he finds success with the basic coding, he decides to build further the relationship of the student who struggles with the AI agent by having the student teach a peer how to create the same simple square with the support of the AI agent. The teacher then realizes the power of the relationship of the AI agent in supporting the students and knows this agent can provide affirming statements to students during instruction. He decides to investigate whether this is helpful to students' self-regulation and confidence in class participation. He finds that if he goes through the use of the agent over time and the relationship is built, the agent has value in the classroom. Initially, he used the agent for student affirmation but found the connection was too foreign and actually was distracting. However, after students learned with and taught

FIGURE 2: The original AI Agent ZB and the Revised ZB from Student Input

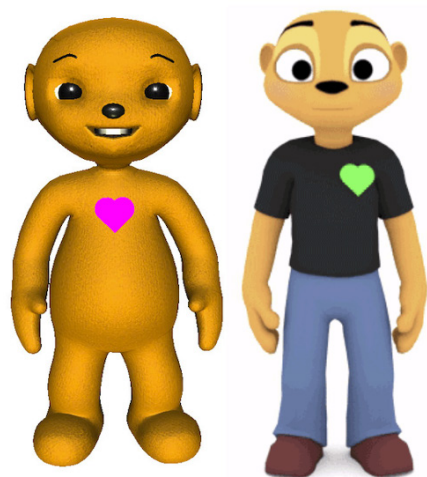
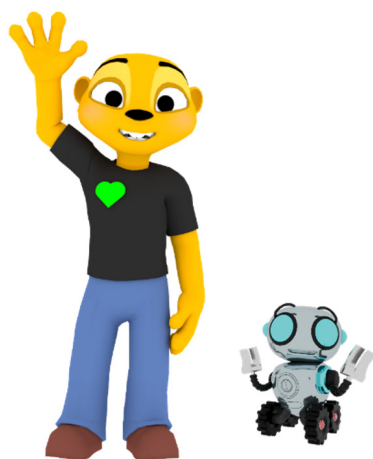


FIGURE 3: The AI agent ZB™ and his partner, Ray-Z



with the AI agent, their relationship was established, and the agent provided a positive connection and not a distraction in the classroom setting.

This example reflects what the team has learned from their project, which is reflected in Mr. Aiden's use of AI agents. This form of AI will not work for all students, but it can be helpful if the student sees a positive relationship with

the agent, which is a critical step for teachers to consider when using agents in the classroom. Figure 1 provides steps to consider when using an AI agent to support student learning.

Changes in Project RAISE and Alignment with Teacher Preparation

Other lessons were learned that teachers should consider. Initially, the appearance of the AI agent selected was considered too juvenile for the upper elementary grade levels, so the team decided to create a revision of the AI agent. They decided to let the students select from several models of an agent. They then had students in the partnership elementary school site vote on their favorite avatar, with the team paying specific attention to the votes of children with disabilities since this was the project's focus. The objective for this revised avatar was to create a "more" mature AI agent. See Figure 2 for images of the original and revised avatars. As teacher educators prepare new teachers to work with those with disabilities, they should consider the authenticity and age-appropriateness of any AI tool being implemented.

This team also learned several other lessons as they ventured into AI agent use with SWD. Initially, existing natural language processing was used to create the dialogue, but the team found that natural language models needed to reflect the unique dialogue presented by the students. The content and complexity of verbalizations can be analyzed using natural language processing (NLP) techniques. Natural Language Processing emerged from interdisciplinary fields and combines computer science, artificial intelligence, and linguistics to enable computers to understand, interpret, and manipulate human language. The use of NLP can help identify patterns of speech, which in this case were used

to program the AI agent using authentic text from the students with ASD.

Using NLP, the team decided to pilot the tool for 2 years with a human-in-the-loop to help create dialogues for the AI agent that were simple, precise, and friendly to the nuances of errors, patterns of speech, and questions posed by SWD. After carefully analyzing the way a skilled human interacted with children who were neurodiverse, the team then used natural language software (Otter.ai) to create an appropriate dialogue for the AI agent.

As teachers are being prepared in special education, new AI agent tools that are considered for use should be analyzed for their ability to respond to potential speech impairments and to ensure the dialogue used is at a level of comprehension and natural exchange for the range of SWD they serve. Teachers also should be aware of the bias that exists in all AI tools, and should specifically find tools that include representation of the range of students with disabilities they might be serving in their future classrooms (e.g., communication board, limited speech ability, lack of clarity in articulation).

Two important lessons were learned to guide teacher educators as they prepare the next generation of special education teachers using AI. First, when AI models are built, be aware they often are built on the "typical" and hold not just race, class, and potential gender bias but often are void of any representation of people with disabilities. Before adopting AI tools, educators should consider biases that may be present based on how they were developed. Second, "less is more" when planning to use AI tools with SWD. In the early development stages, the project team used an iPad, Blockly the robot, a taped square, and a biometric device, and students were taken into another room with a tech coach to conduct this study. Realizing a need to consolidate the tools and time, the team

created Ray-Z so all tools needed for the project were available in one space (See Figure 3 for images of ZB™ and Ray-Z the AI tools used in the project). This containment in one setting and one platform on the computer gave the team a focused setting to use facial tracking to mirror the student's emotions in the AI agent ZB™. Students could still see the AI agent while coding the robot on the iPad. A biometric device, the Polar Verity Sense, was also placed on the student to help understand stress, but in the future, the goal is to eliminate this added device and move to an iPad or laptop that can pick up these same biometric signals using just a camera. The team also learned that providing the AI agent within the classroom may be difficult with logistics for space and time, internet and Bluetooth connections, and teacher time; however, it works better for the students and reduces the overall classroom disruption of students leaving and entering the classroom. A final challenge of the project is to make this easy for teachers to use, which has been the recent focus.

Initially, this project was delivered by a research team but evolved to teachers directly overseeing all project phases in Fall 2023. From the start of the project, the team wanted to help students and teachers understand the stress of SWD by using biometric devices connected to the AI agent to generate a customized response to the learner. The team progressed in comprehending the nature, utilization, and intricacies of biometric data concerning children and its role in activating AI agents to help teachers (Hughes et al., 2022; Ali et al., 2023).

Research Goals

To investigate the potential of the AI agent in supporting student communication and self-regulation goals, the research team focused on increasing interactions and time on task of participants.

In the area of communication, the team specifically studied verbal reciprocity. In the development stage, the team examined Phase 1 conversations between the participant and the AI agent. Once the project's pilot stage was underway, the team studied interactions in Phase 2 between participants and peers working together to code the robot. In Phase 3 the emphasis shifted to participants' interactions with their teacher and peers during mathematics instruction with the AI agent providing social-emotional support. During mathematics instruction, the teachers implemented a think-pair-share strategy to ensure student communication could continue with their peers and prompted by the AI agent. The team provided professional development to ensure teachers understood the think-pair-share strategy and the importance of implementation fidelity at this stage. During Phases 1 and 2 of the study, the learning was student-driven, with ample opportunities to initiate a conversation with either the AI agent or, in Phase 2, a peer and the agent. In Phase 3, the teacher conducted the classroom routine, with the AI agent providing social-emotional support to the participant.

Teacher educators can support teacher candidates in learning new AI tools, but grounding them in evidence-based and high-leverage practices is important to ensure positive outcomes even when integrating an AI tool. Teacher preparation programs need to help teachers today not just think about room arrangements for grouping but also the logistics behind charging devices, integrating devices into instruction, creating centers for learning coding, or using evolving AI tools that are student-driven and teacher-independent. One aspect of Project RAISE is that the tools used are evidence-based practices but require limited teacher time and interaction. These AI tools used in the classroom can set new teachers up for success and create a

more robust learning environment for differentiation for students with disabilities.

Findings to this Point and Teacher Application

After a comprehensive analysis of the data from 2023, it became evident that quantifying the frequency of student opportunities to initiate conversations or to respond to others would provide more insightful findings. Further assessment revealed improvements across all communication aspects, from pre-observations to post-observation evaluations. Instances of teacher-led peer-to-peer interaction opportunities surged from 127 across teachers to 220 with the same teachers in 2023, while SWD responses demonstrated a slight increase. Notably, student engagement with peer inquiries achieved a 100% response rate, with peer-generated questions rising from 14 to 23. Student-initiated interactions with both teachers and peers demonstrated significant growth, escalating from 111 to 207 and from 122 to 220, respectively. These results highlight a substantial improvement in communication dynamics across all assessed categories from the initial to the final assessments ensuring teachers used a simple think-pair-share strategy and providing support from an AI agent during mathematics instruction.

A few barriers to consider in working with new and innovative ideas based on this project were identified as persistent issues as the project was scaled to multiple schools and districts. First, school-based instability still exists with basic internet connectivity. This instability impacted the ability of teachers to access the web-based platform and, at times, caused them to become frustrated with the project system. In this project the team found solutions such as providing hotspot devices to ensure dependability during the research sessions, but that is not an option usually available to a

teacher. A second barrier, especially early in the study, was implementation fidelity. Although training was provided, some teachers required follow-up discussions to ensure the think-pair-share strategy was being used as intended. Based on the year 4 teacher survey results, the think-pair-share strategy utilized in the study was shown to be valuable to teachers beyond the project. This emphasizes how good teaching practices are beneficial to students with disabilities beyond the scope of this study and are still needed even with AI-driven or supported instruction.

The support for using these strategies by administrators has been positive, with administrators and teachers choosing to sign up to use the AI agent. Administrative and technology support are essential for AI use, but knowing how to show the strengths, limitations, and safeguards of tools being adopted is essential to preparing teachers for this new frontier of potential use or misuse of emerging tools. Helping teacher candidates understand how they can engage students with technology and provide needed accommodations or modifications should be part of a preparation program in special education. Teacher educators need to prepare teacher candidates for the safe and ethical use of AI, and a great resource to consider is the ISTE Standards (2000). Also, vetting the tools used and knowing how to work with administrative and technology teams, as well as ensuring privacy and safeguards for the tools used, are critical considerations for the field.

Use of AI agents in Classroom

Based on our research, this team supports using AI agents in classrooms to provide support in teaching content and supporting students' social-emotional needs. The team further believes that these tools can help alleviate the stress many teacher candidates feel (Brady et

al., 2023; Saloviita & Pakarinen, 2021; Leko et al., 2024) and perhaps help with a critical need in the recruitment and retention of special education teachers (Rock et al., 2023). However, the process for using these tools and understanding what is “under the hood” of any AI agent used needs to be a part of the discussion in teacher preparation programs. For example, machine learning models have great promise in education, both for student success and as tools to aid teachers in better understanding their students. These algorithms can provide teachers with information on their students' physical presence, stress levels, and focus. Using physical presence, the AI agent can encourage more involvement by the student if he or she loses focus, which can often be assessed by eye gaze (Stiefelhagen et al. 1999, Massé et al. 2017). For teachers to understand the specific benefits of AI tools such as these, more specific applications must be presented and readily available. The current project includes these metrics to drive the dialogue and expressions of an AI virtual companion (AIC) dedicated to an individual student.

Challenges in AI Use for Emotional Responses

While physical presence and focus based on eye gaze are objective measures easily determined by vision-based algorithms, stress can involve many measures that vary by individual. e.g., heart rate, blood pressure, respiration, facial expression, frequency, variability, intensity, and timing of speech (Nemcova et al., 2020; Rojo Lopez et al. 2021). Some of these can be assessed with simple non-invasive solutions using a camera (facial expression), and a microphone (speech attributes). The others (heart rate, blood pressure, and respiration) have commonly been measured using biosensor devices (Shen et al. 2021). However, recent advances in

vision-based approaches have mitigated and, for many applications, replaced biosensors with analysis of facial camera input (Perepelkina et al., 2020). In this project, an AI-based method can detect emotions using biosensors, vision-based physiological signal, and facial expression analysis.

In this real-time application, barriers to use were identified. One limitation is that participant faces may be occluded due to head and body movements and low illumination. Similarly, background noise can make voice signals noisy in classroom environments. The project team moved to physiological signals acquired from biosensors to detect emotion and stress levels in such scenarios. Moreover, using multiple modalities is now a common approach in machine learning to determine emotion, providing more robust solutions to variable classroom environments (Sharma & Dhall 2021).

Unfortunately, the interpretation of emotion indicators, whether through unimodal or multimodal data, can be highly subjective, as baselines for people vary, and generalization of the machine learning algorithms to unseen data is challenging. As a result, biases can arise based on many human attributes, including age (Kim et al. 2021), skin tone (Halberstadt et al. 2021), culture (Li & Deng 2020), and neurological differences (Yitzhak et al. 2020).

In this project, the approach was to be supportive and never critical, much like what is taught to teacher candidates using positive behavioral support models (Sugai & Horner, 2009). The AI agent's interaction with the participants aligned with the overall philosophy of PBIS, which was to create a safe and predictable environment for student success. This supportive model used by the AI agent involves uttering encouraging messages and maintaining a positive facial expression and body pose. In cases

TABLE 1: Microsoft Co-Pilot’s Response to the Future of AI in Teacher Preparation

<p>“The integration of AI-agents with biometric data in teacher preparation holds significant potential for transforming education.</p> <div><div><div><div><div>1. Holistic Student Development:</div><div><div>○ AI can accelerate students’ holistic development by providing personalized learning experiences. It can analyze biometric data (such as heart rate, facial expressions, and attention levels) to gauge student engagement and well-being.</div><div>○ Teachers can receive real-time insights into students’ emotional states, allowing them to tailor their teaching approaches accordingly.</div></div></div><div><div>2. Equitable Education:</div><div><div>○ AI can help identify learning gaps and adapt content to meet diverse student needs. By integrating biometric data, it can recognize when a student is struggling or disengaged.</div><div>○ Teachers can then intervene promptly, ensuring that no student falls behind.</div></div></div><div><div>3. Teacher Professional Development:</div><div><div>○ Biometric data can enhance teacher training. For instance:<div><div>■ During practice teaching sessions, AI-agents can analyze teachers’ facial expressions, voice tone, and body language to provide feedback on their effectiveness.</div><div>■ Biometric data can also assess stress levels, helping teachers manage their well-being.</div></div></div><div>○ By automating routine administrative tasks, AI could streamline teacher workflows, giving them more time to build relationships with students and foster their learning and development.</div></div></div><div><div>4. Ethical Considerations:</div><div><div>○ While the benefits are promising, we must address ethical concerns related to privacy, consent, and bias.</div><div>○ Transparent guidelines are essential to ensure responsible use of biometric data in education.</div></div></div></div></div></div>
<p>In summary, AI-agents with integrated biometric data can revolutionize teacher preparation, making education more inclusive, personalized, and effective.” (Microsoft Co-Pilot, 2024).</p>

where the algorithm detects a continued lack of attention, the AI companion gently says a phrase such as “Boy, it can be hard to stay on task, but let’s try.” In cases where stress seems to increase, the team’s approach always treats a machine-determined emotion category as a suggestion, not necessarily a fact. Using this point of view, our system triggers the AI agent to behave in a way that would support an individual who is stressed but in a manner that is also supportive of any learner.

As a simple example of handling apparent stress, the AI agent might indicate

that it needs some help getting its focus back and ask the participant to help it do breathing exercises. The system can then use respiration data from the student to affect the AI agent’s breathing rate (chest expansion and contraction). If the student is breathing too fast, the AI agent could suggest that it would like to relax. This approach puts the control in the hands of the student, is non-disruptive to the class, and is a strategy we feel is preferable to the AI agent labeling the child’s emotion in a way that may be interpreted as the AI agent being dominant or using potential bias.

Future Connections of AI Agents to Teacher Education

Using AI agents in the classroom could involve a complex system like the one created by Project RAISE, an open-source, free tool designed for use by teachers. Alternatively, teachers may increasingly have the opportunity to create simple AI tools for skill or social-emotional acquisition using an ever-increasing array of online tools. New voice-generated AI tools by OpenAI or Google Gemini and other companies will support the potential for teachers to have AI agents, much like a Pet Rock or

a Furbee of the past. Teachers can create more sophisticated AI agents, chatbots (e.g., <https://mizou.com> creates bots in 50 languages or <https://chaindesk.ai> creates a custom chatbot with no programming), and robots (e.g., Moxie, Dash or Loona) to provide behavioral and learning support. For teacher educators, this means modeling the use of current technology, and, for teachers, it requires openness to trying new tools while keeping in mind data privacy, bias, and security issues. For example, Project RAISE has made all tools web-based with the option to “just use” the tool without recording or using biometric data. The integration of AI tools is the future and teachers and those who prepare them need both acceptance and access to these tools to assist them and the students they teach.

The future use of AI agents and biometrics in teacher education is unknown, but results of the following prompt provided to Microsoft Co-Pilot, “What is the future use of AI agents with integrated biometric data in teacher preparation?” and provided in Table 1 offers a glimpse of what could lie ahead in the area of AI.

Integrating Project RAISE, focusing on socially assistive AI agents like ZB™ and Ray-Z, the robot, into teacher preparation programs could significantly enhance future educators’ competency in leveraging technology for inclusive education. Considerations for project use of RAISE and other AI-agent usage in teacher preparation programs are provided.

Curriculum Development. Teacher preparation programs can include modules or courses on designing and implementing technology-based interventions for students with disabilities. Project RAISE can serve as a case study or a core component of these modules, providing insights into the development, application, and impact of socially assis-

tive technology in educational settings.

Hands-on Training. Future teachers can receive hands-on professional development (PD) in using socially assistive AI agents and robots within the classroom. This PD could involve simulations and role-playing exercises in controlled environments, such as in TeachLivE (Dieker et al., 2023) housed at the University of Central Florida in the Center for Research in Education Simulation and Technology, to practice engaging students with diverse learning needs through these technologies.

Enhancing Understanding of Executive Functioning. Programs can use these tools to discuss how to help students with executive functioning skills and their importance in educational success. Teacher candidates might reflect upon how technologies, like those in Project RAISE and other off-the-shelf AI agent tools, could be used to support these skills. By understanding the principles behind Project RAISE’s approach to enhancing executive functioning, teacher candidates can design interventions tailored to their future students’ needs.

Interdisciplinary Collaboration. Teacher preparation programs could foster interdisciplinary collaboration by involving special education, psychology, and computer science experts to provide a holistic view of how technology can support students with disabilities. This approach mirrors the collaborative effort seen in Project RAISE, offering future teachers a model for working across disciplines to enhance educational outcomes including promoting collaboration with a range of general education teachers.

Research and Innovation in Educational Technology. Teacher educators should encourage teacher candidates to engage in research projects that explore the effectiveness of socially assistive AI agents in supporting students with disabilities. This research could involve

assessing the impact of AI agents on social skills, executive functioning, and academic achievement, contributing to the evidence base for best practices in the use of educational technology.

Innovation Labs. Teacher educators should consider creating in-person or online innovation labs where future teachers can develop their own educational technologies, potentially including the tools from Project RAISE. They should also consider reviewing other OSEP Stepping Up grants that involve many novel technological tools. These innovation labs could provide a creative space for prototyping new tools and methods for inclusive education, fostering a culture of innovation among teacher candidates in the rapidly emerging world of AI.

Professional Development and Continuous Learning. Teacher educators should ensure their programs include components that stress the importance of ongoing PD in educational technology. Graduates need to be equipped with the skills to continually assess and adopt new technologies, like those developed in Project RAISE, to meet the evolving needs of their students. Yet, with a critical lens and understanding of national standards and guidelines, teachers can be prepared to protect students’ privacy and identify potential bias in AI tools being used. By integrating online and free open education resources, like Project RAISE, into teacher preparation programs, future educators are not only equipped with knowledge and skills to use advanced technology in the classroom but they are also inspired to innovate and contribute to the effective use of AI in the support of student learning and the field of inclusive education. This approach prepares them to meet the diverse needs of their students, fostering an inclusive, engaging, and supportive learning environment for all.

The Project RAISE initiative, by

integrating the socially assistive AI agent ZB™ and Ray-Z robot into classroom settings, provides a foundation for exploring the use of AI agents to support executive functioning skills among students with disabilities. Considering the project's focus on enhancing social skills through interactive and collaborative learning experiences, extending its application to include executive functioning is a natural progression.

To effectively implement this extension, the design and programming of AI agents must be informed by pedagogical principles and evidence-based strategies targeting executive functioning. This includes creating tasks requiring planning, organization, task initiation, and emotional regulation. Additionally, incorporating feedback mechanisms that reflect on the student's performance and decision-making processes can further support the development of these skills.

Integrating executive functioning skills into Project RAISE involves strategically using the socially assistive AI agents, ZB™, and Ray-Z robot. These agents can facilitate activities that specifically target and develop crucial cognitive abilities (e.g., coding) or support social-emotional regulation.

Future Implications of AI in Teacher Preparation and Educational Settings

There is a great deal of public excitement and concern surrounding the use of AI in education based on the abilities of ChatGPT, Llama, Gemini, Microsoft Co-Pilot, and other Large Language Models (LLMs). Given the right textual prompts, these tools can produce credible and sometimes jaw-dropping text. Even more impressive are AI agents built on these platforms, such as Dall-E (photorealistic images) and Sora (short photorealistic videos). But, all AI tools can also provide what is termed

“hallucinations,” which provide false information. Think about when you ask your smart home device what the weather is, and it gives information for the wrong city, or you ask for a specific question, and you get a vague, wrong, or no response. With this potential dichotomy of outcomes from AI, caution and human review of all information produced is essential.

Many students are tempted to use these tools to do assigned work without even checking the outcomes' validity (often lacking). Others realize these are just learning companions that can help get the creative juices flowing. This view sees AI-enabled systems as advanced versions of existing, accepted tools like search engines and Wolfram Alpha, each of which can guide your thinking or be used just to get answers.

At this stage, many teachers consider using AI tools in creative activities like writing and art as cheating, whereas others are embracing the inevitable and encouraging the use of these as sources of inspiration. Creative teachers are now using AI to inform their classroom activities, develop assignments, and produce informative visuals, just as some more enterprising members of the public use these tools to quickly draft holiday letters.

The threat that AI enables false narratives to be created and spread at blinding speeds and can share false information, videos and images of events that never happened continues to exist. Historically, every advancement comes with downsides. The key is universal education and a re-emphasis on open, productive dialogue among humans, who are now aided by new digital partners.

Another persistent challenge of using AI is that generative AI requires large amounts of data. In this stage of rapid advancement, AI is built based on large data sets that are readily available. However, these datasets may not accurately reflect students in specific educational

contexts, especially inclusive educational contexts with students who are neurodiverse. As we build better data sets with attention to representing diverse students, AI virtual agents are likely to improve and become more responsive to individual students, learning how to differentiate agent behavior to maximize student learning. As multimodal data collection and signal interpretation improve, AI virtual agents will likely make decisions based on individualized data with increased confidence. In the future, AI virtual agents may become as varied and unique as the students with whom they work. Future research should continue exploring AI agents' potential in education, focusing on innovative solutions to overcome the barriers to their effective implementation.

CONCLUSION

This current interdisciplinary team sees the potential of AI-agent use in classrooms to support both teacher and student learning. Yet, even with 4 years of immersive work in this area, the team cautions the field that the use of AI with students has as many questions as there are answers. This team enthusiastically embraces the potential support these tools can provide with mindful preparation of teachers and the administrators who will support them to ensure that this evolution of AI does not further stress an already overtaxed and understaffed profession, teachers in special education. This team believes the power of AI lies in teachers thinking differently about instruction by being prepared differently to think about the potential of these evolving tools to fill gaps in areas of deficit and to allow students to create in areas of strength. The power of AI and any biometric data should lie with the students' use of this information to help them as learners, which is the ultimate goal of teacher preparation in any discipline.

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