THE SYNERGY OF PEDAGOGICAL MENTORING AND ARTIFICIAL INTELLIGENCE IN ENHANCING TEACHER DEVELOPMENT

Author(s) / Szerző(k):
Birescu, Mihaéla (Ph.D.)
Gál Ferenc University

E-mail:
mihaela.birescu@gmail.com

Cite: Birescu, Mihaéla (2025): The Synergy of Pedagogical Mentoring and Artificial Intelligence in Enhancing Teacher Development. *OxIPO – Interdiszciplináris tudományos folyóirat*, VII. évfolyam 2025/1. szám. 35-56.
Idézés: Doi: https://www.doi.org/10.35405/OXIPO.2025.1.35

EP / EE: Ethics Permission / Etikai engedély: KFS/2025/0003

Reviewers: *Public Reviewers / Nyilvános Lektorok:*
Lektorok: 1. Olteanu Lucián Liviusz (Ph.D.), Gál Ferenc Egyetem
2. Lestyán Erzsébet (PhD.), Gál Ferenc Egyetem

Anonymous reviewers / Anonim lektorok:
3. Anonymous reviewer (Ph.D.) / Anonim lektor (Ph.D.)
4. Anonymous reviewer (Ph.D.) / Anonim lektor (Ph.D.)

Absztrakt

A PEDAGÓGIAI MENTORÁLÁS ÉS A MESTERSÉGES INTELLIGENCIA SZINERGIÁJA A TANÁRKÉPZÉS FEJLESZTÉSÉBEN

Ez a tanulmány a pedagógiai mentorálás és a mesterséges intelligencia (MI) közötti szinergikus kapcsolatot vizsgálja a tanárképzés fejlesztésében. Az oktatás a digitális korszakban gyorsan fejlődik, és a pedagógusokra egyre nagyobb nyomás nehezedik, hogy alkalmazkodóképes tanítási stratégiákat sajátítsanak el, valamint technológiai jártasságot szerezzenek. A pedagógiai mentorálás továbbra is kulcsfontosságú eszköz a gyakorlat és az elmélet közötti szakadék áthidalásában: érzelmi támogatást, reflexív fejlődést és gyakorlati iránymutatást kínál a pályakezdő tanároknak. Ezzel egyidejűleg az MI méretezhető, adatvezérelt eszközöket biztosít, amelyek személyre szabják a tanulást és valós idejű visszajelzést nyújtanak. A mentorálás és az MI integrálása sokoldalú

megközelítést eredményez a szakmai fejlődésben, amely ötvözi az emberi empátiát és a technológiai pontosságot. Az MI analitikai eszközökkel és adminisztratív automatizálással támogatja a mentorokat, míg a mentorok kontextusba helyezik és humanizálják az adatokat, biztosítva azok értelmes és etikus alkalmazását. Ez a hibrid modell a folyamatos fejlődés, a reflexióra épülő gyakorlat és a bizonyítékalapú oktatás kultúráját erősíti, amely elengedhetetlen a 21. századi oktatásban. A cikk végső megállapítása, hogy az MI nem a mentorok helyettesítésére, hanem azok megerősítésére szolgál a válaszképes, innovatív és ellenálló pedagógusok nevelésében.

Kulcsszavak: pedagógiai mentorálás, mesterséges intelligencia az oktatásban, tanárképzés, személyre szabott tanulás, reflektív gyakorlat, szinergia

Diszciplinák: pedagógia, pszichológia, informatika

Abstract

This article explores the synergistic relationship between pedagogical mentoring and artificial intelligence (AI) in enhancing teacher development. As education rapidly evolves in the digital age, teachers face increasing demands for adaptive teaching strategies and technological fluency. Pedagogical mentoring remains a critical tool in bridging the gap between theory and practice, offering emotional support, reflective growth, and practical guidance to novice educators. Simultaneously, AI introduces scalable, data-driven tools that personalize learning and offer real-time feedback. When integrated, AI and mentoring provide a multifaceted approach to professional development that leverages both human empathy and technological precision. AI supports mentors with analytics and administrative automation, while mentors contextualize and humanize the data, ensuring meaningful, ethical application. This hybrid model fosters a culture of continuous improvement, reflective practice, and evidence-based instruction, essential in 21st-century education. Ultimately, the article argues that AI should not replace mentors but rather empower them in cultivating responsive, innovative, and resilient educators.

Keywords: pedagogical mentoring, artificial intelligence in education, teacher development, personalized learning, reflective practice, synergy

Disciplines: pedagogy, psychology, IT

The educational landscape of the 21st century is undergoing a metamorphosis, characterized by the convergence of rapid technological advancements, shifting societal expectations, and the constant evolution of pedagogical paradigms (see: Bayly-Castaneda et al., 2024). Educators are now confronted with an array of

challenges that demand expertise beyond subject matter mastery; they must cultivate adaptive teaching methodologies, foster inclusive and responsive learning environments, and engage in continuous professional development to keep pace with digital innovations (Ellikkal & Rajamohan, 2024). In this era of digital transformation, educators must also be aware of the opportunities presented by technology, possess the skills to analyze data from intelligent systems, and integrate these insights into their pedagogical approaches, guiding students through personalized learning pathways.

Pedagogical mentoring serves as a cornerstone of professional development, built upon interpersonal relationships and hands-on experiences, facilitating the conveyance of practical and tacit knowledge that formal teacher training programs often undersupply ("OECD Digital Education Outlook 2021," 2021). Mentorship offers an avenue for novice instructors to assimilate the nuanced technical skills essential for effective teaching, concurrently fostering a profound comprehension of the emotional and ethical considerations intrinsic to the profession. Mentors can assist in bridging the gap between theoretical knowledge and practical application by providing personalized feedback, sharing effective strategies, and co-reflecting on classroom experiences, which is particularly valuable given the limitations of traditional one-size-fits-all methodologies (Pahi et al., 2024). As novices gain exposure to experienced guidance, they will know the value of lifelong learning and reflective practice, as well as the importance of staying current with emerging technologies and adapting their instructional practices to meet the needs of diverse learners.

Simultaneously, the burgeoning presence of artificial intelligence (AI) in education introduces novel tools that afford scalable, personalized support mechanisms. AI-driven platforms are capable of scrutinizing teaching performance, tailoring resources to accommodate individual learning preferences, and furnishing real-time feedback, thus augmenting and enriching conventional mentoring modalities (see: Shaffer et al., 2015). AI systems can analyze vast datasets to identify patterns in student learning, predict areas of difficulty, and recommend targeted interventions, thereby enabling educators to make data-informed decisions and personalize instruction to an unprecedented degree (Demartini et al., 2024). AI can also support the creation of well-designed long-term curricula and connect appropriate learners. Implementing AI in education compels a meticulous evaluation of ethical considerations, encompassing data privacy protocols and ensuring that AI tools are deployed to augment, rather than supplant, human engagement and pedagogical guidance (Rizvi, 2023).

The convergence of AI and human mentorship should be viewed not as an adversarial replacement, but as a synergistic alliance, where AI furnishes data-

driven insights and heightened accessibility, while human mentors impart empathy, contextual acumen, and moral direction. This amalgamation enables a more holistic and efficacious approach to professional development, wherein AI tools facilitate the identification of professional development needs, promote reflective practice, and foster evidence-based teaching methodologies, while human mentors furnish the nuanced guidance and emotional support imperative for navigating the complexities of the teaching profession. Educators play a central role in this evolving AI-integrated ecosystem by curating personalized learning experiences through intelligent moderation and ensuring the responsible and ethical application of technology to enhance student learning outcomes (Nafea, 2018). In this human-AI collaboration, it is essential to ensure AI complements traditional learning, upholds academic integrity, and promotes critical thinking.

The pivotal role of pedagogical mentoring in educators' development

Pedagogical mentoring assumes the main role in shaping effective and confident educators by establishing a relational framework where experienced teachers guide their novice counterparts through supportive interactions, insightful counsel, and constructive feedback. This mentoring extends beyond simple knowledge transfer, fostering a dynamic dialogue that cultivates professional growth, emotional fortitude, and reflective teaching practices (Tanjung et al., 2021). Mentoring is a tool for bridging the gap between educational theory and practical application, offering authentic learning experiences grounded in real classroom environments. Mentors facilitate the navigation of challenges such as lesson planning, classroom management, and differentiated instruction through observation, collaborative teaching, and constructive dialogues (Bradbury, 2010). Mentoring has an impact on teacher retention and job satisfaction, as studies indicate that structured mentoring programs correlate with higher retention rates, increased confidence, and greater competence among beginning teachers (Bhebhe, 2022). Addressing the critical issues of teacher shortages and high turnover rates, mentoring offers a tangible solution by providing the necessary support and guidance to retain educators within the system. Implementing robust mentoring programs is not merely an investment in individual teachers but a strategic imperative for bolstering the overall quality and stability of educational institutions, ensuring a continuous cycle of improvement and adaptation within the teaching profession. Mentoring not only aids the growth of new educators, but also enriches the mentor's teaching repertoire and personal attributes (Goldberg, 2018). through the process of guiding and reflecting on their own practices, mentors often experience renewed enthusiasm for

their profession, fostering a culture of continuous improvement within the educational community (Ojo et al., 2017).

Key dimensions of pedagogical mentoring include knowledge transmission, where mentors model professional behavior, ethical decision-making, and interpersonal skills alongside instructional strategies. Skill development is also paramount, as mentors facilitate the refinement of mentees' pedagogical techniques through the provision of guided practice and actionable feedback, enabling them to adapt their instructional approaches to accommodate a spectrum of learner profiles and the multifaceted demands of contemporary curricula. Mentoring programs enhance the abilities of new teachers and improve their commitment to teaching and their capacity to handle the complexities of classroom environments. It also extends beyond the immediate classroom setting, addressing the broader professional responsibilities of educators, such as collaboration with parents, engagement in school-wide initiatives, and adherence to ethical guidelines. Mentors often act as cultural ambassadors, helping new teachers understand and navigate the unspoken norms, values, and expectations of the school community, thus fostering a sense of belonging and integration (Rockoff, 2008). The mutual benefits model of mentoring suggests that mentors gain public recognition for their expertise, while novice teachers receive crucial support during their initial years. Mentoring relationships promote a growth-oriented mindset, where both parties are encouraged to embrace challenges, learn from mistakes, and continually seek opportunities to enhance their professional capabilities. Mentoring can be seen as a teaching metaphor that emphasizes the learner and promotes positive results, allowing for a new assessment of teaching and the learning process and creating prospects for change and renewal (Enerson, 2001). By embracing mentoring as a cornerstone of teacher development, educational institutions can cultivate a cadre of educators who are not only skilled practitioners but also reflective, resilient, and deeply committed to the success of their students. The bidirectional nature of mentorship, whether formal with structured assessments or informal through experienced guidance, yields benefits such as increased job satisfaction, research opportunities, and grant publications for the mentee.

Artificial intelligence as a support tool in teacher development

Artificial intelligence is rapidly changing the landscape of education, presenting unprecedented opportunities to transform teacher training, support mechanisms, and evaluation protocols (Luan et al., 2020). Rather than merely automating existing processes, AI introduces innovative approaches to personalized instruction,

insightful feedback, and immersive experiential learning, which collectively have the potential to significantly enrich both pre-service and in-service teacher education programs. By harnessing the power of large-scale data analytics and sophisticated machine learning algorithms, AI-driven systems can discern subtle teaching patterns, forecast learning outcomes, and tailor educational resources to meet the unique requirements of individual educators (Zhai et al., 2021; Zhou et al., 2023). These advanced systems offer scalable solutions to address persistent challenges in teacher education, such as the imperative for ongoing professional development, customized support structures, and comprehensive performance evaluations. As educational environments become increasingly digitized and data-intensive, AI tools can foster dynamic and responsive ecosystems where educators can engage in continuous self-reflection, professional growth, and real-time innovation. The integration of AI into education holds the promise of redefining traditional teaching and learning paradigms (Mello et al., 2023).

The capacity to deliver personalized learning experiences stands out as one of the most impactful contributions of AI to teacher development. AI-driven platforms can meticulously monitor teacher-student interactions, classroom dynamics, and instructional strategies through sophisticated integrated analytics, thereby offering real-time, actionable feedback tailored to individual teaching profiles. For instance, these systems can identify imbalances in student participation, a tendency to rely excessively on teacher-centered instruction, or a lack of digital tool utilization, and subsequently generate targeted recommendations (Ma et al., 2024). Such adaptive support mechanisms can significantly enhance pedagogical responsiveness, particularly for novice teachers who are still in the process of refining their skills. AI-driven assessment tools have the capability to analyze student responses in real-time, affording immediate feedback and providing profound insights into the nuances of student comprehension and learning progression (Onesi-Ozigagun et al., 2024). By analyzing extensive datasets, AI systems can discern patterns in a student's engagement with e-learning modules, thereby revealing their preferred learning styles or specific areas of academic difficulty (Jian, 2023). Advanced AI algorithms are adept at examining student performance data with exceptional granularity, proactively identifying students who may be susceptible to academic challenges or at risk of not meeting learning objectives, which empowers educators to implement targeted interventions and personalized support strategies in a timely manner (Harry & Sayudin, 2023). Furthermore, AI facilitates nuanced evaluations of educators' integration of technology into their pedagogical practices, delivering specific, actionable insights on optimizing digital tools and resources to cultivate more engaging and effective learning environments, ultimately

amplifying the impact of educational experiences (Dey, 2025; Jian, 2023).

The versatility of AI extends beyond personalized learning and feedback, offering a spectrum of tools that can automate administrative tasks, analyze student behavior, and provide support for students with special needs (Lampou, 2023). The integration of AI into learning applications provides support systems and scaffolding for students as they navigate personalized learning pathways. AI-driven dashboards provide educators with real-time data visualization, enabling them to make informed decisions regarding instructional strategies and resource allocation. AI-driven systems are also revolutionizing assessment and feedback mechanisms, automating the grading of assignments and providing students with timely, detailed feedback, which significantly reduces the administrative burden on teachers, allowing them to focus on more strategic instructional activities (Roméro et al., 2023). By leveraging AI, educators can gain insights into students' emotional states through facial expression analysis, which facilitates early intervention and targeted support (Saputra et al., 2023; Vistorte et al., 2024). Additionally, AI-enabled adaptive learning systems can be programmed to offer tailored assistance and customized learning pathways for students with diverse learning requirements, ensuring inclusivity and promoting equitable educational opportunities by dynamically adjusting the complexity and pacing of instructional materials (Bayly-Castaneda et al., 2024).

AI-driven systems can assess and provide feedback on assignments, quizzes, and exams promptly, allowing students to understand their strengths and weaknesses in real-time (Kaledio et al., 2024). These systems, through sophisticated algorithms, can detect plagiarism, ensuring academic integrity and promoting ethical behavior among students, further enhancing the quality of education. AI can be integrated into educational tools to personalize learning, improve engagement, support teachers, and provide accessible education for all students. Personalized learning systems, powered by AI algorithms, analyze student data to create customized learning experiences for each student, while AI-enabled chatbots provide individualized support by answering student inquiries (Lin et al., 2023). AI systems streamline administrative tasks, enhance personalized learning experiences, and offer valuable insights into student performance and behavior (Onesi-Ozigagun et al., 2024). The personalized approach, driven by AI, benefits both students and teachers, which leads to improved learning outcomes and overall educational experiences. AI–based platforms precisely acquire the student's characteristics by observing past experiences and analyzing available big data through exploring the learners' features and similarities (see: Maghsudi et al., 2021). The adaptive nature of AI tools was significant in ensuring student engagement and keeping them

motivated to learn ("Global Educational Studies Review," 2020; Rizvi, 2023).

The synergy between mentoring and artificial intelligence

The confluence of artificial intelligence and human mentoring presents a paradigm shift in educational support systems, offering a symbiotic relationship that leverages the strengths of both domains. Rather than positioning AI as a substitute for human mentors, the contemporary perspective underscores the potential for a complementary and synergistic alliance (Haensly & Parsons, 1993). AI excels in managing repetitive and data-intensive tasks, providing efficiency and scalability, while human mentors contribute empathy, contextual awareness, and nuanced professional judgment—attributes that remain beyond the reach of AI (Mena-Guacas et al., 2023). This integration aims to amplify the efficacy, accessibility, and precision of mentoring programs, guaranteeing that mentees gain access to timely, personalized, and evidence-driven guidance. Mentors can leverage AI-driven analytics to gain deeper insights into mentee progress, enabling them to tailor their guidance more effectively and provide targeted support that addresses specific needs and challenges (Mah & Gross, 2024). The amalgamation of human mentoring with AI assistance has the potential to redefine creative education by enhancing various aspects of the learning process (Zailuddin et al., 2024).

The integration of AI into mentoring workflows fosters more focused and data-enriched mentor-mentee dynamics. AI platforms have the capacity to continuously monitor mentee development across a spectrum of competencies, including instructional design, classroom management techniques, and technology integration, and to generate comprehensive reports that empower mentors to pinpoint areas of strength and areas requiring further development. These insights enable mentors to personalize their support and provide targeted interventions that address the specific needs of each mentee, thereby enhancing the effectiveness of the mentoring relationship.

AI-driven tools facilitate asynchronous communication channels, which include annotated video feedback, AI-generated discussion prompts, and chatbots designed to address common inquiries. These resources extend mentoring interactions beyond con-ventional scheduled meetings, promoting continuous engagement and reflection, which are crucial for sustained professional growth (Onesi-Ozigagun et al., 2024). The application of AI in education is not aimed at supplanting educators but rather at augmenting their capabilities and creating a more stimulating and productive learning environment (see: Lampou, 2023).

Effective mentoring is contingent upon a well-established feedback loop, which AI systems can fortify by delivering real-time, objective data that complements qualitative mentor observations. For example,

data analytics derived from classroom management software or learning management systems can provide actionable insights into student engagement levels and academic performance, which can inform mentor feedback and guidance. This data-driven feedback mechanism ensures that mentees receive timely and specific guidance, which facilitates continuous improvement and professional development. AI-driven assessment tools possess the capability to dissect student responses in real-time, affording immediate feedback and supplying insights into student comprehension and learning trajectories. By analyzing a student's interactions with e-learning modules, AI can discern patterns indicative of preferred learning styles or areas of struggle (Jian, 2023). This enables educators to personalize the delivery of content and provide customized support, thereby optimizing the learning experience for each student.

The integration of AI in education also permeates administrative functions, streamlining tasks like student enrollment, scheduling, and resource allocation. AI-powered systems are able to optimize these processes, resulting in more efficient and effective management of educational institutions (Onesi-Ozigagun et al., 2024).

AI driven technologies can be interwoven into pedagogical practices through the implementation of intelligent educational tools, personalized learning software, and virtual assistants. These resources have the potential to reshape educational paradigms, personalize learning experiences, and equip both educators and students with innovative instruments for academic advancement. Personalized learning systems, propelled by AI algorithms, scrutinize student data to curate individualized learning pathways tailored to each student's unique requirements. AI algorithms analyze data, identify patterns, and make predictions, enabling educators to personalize learning for each student (Harry & Sayudin, 2023). By taking advantage of AI/ML methods, the educational platform precisely acquires the student's characteristics (Maghsudi et al., 2021). Such an approach facilitates self-paced learning, addresses specific knowledge gaps, and provides targeted interventions to maximize student outcomes. The emergence of AI-driven tools presents opportunities to offer students customized support and resources, thus fostering an enriched and efficacious educational journey.

The transformative potential of AI lies in its capacity to analyze extensive datasets, discern patterns, and generate predictions, thereby enabling educators to make well-informed decisions and personalize learning encounters. Through the meticulous examination of student engagement metrics, granular performance analytics, and nuanced learning behavior patterns, AI systems are uniquely positioned to furnish educators with actionable insights that directly inform the refinement of instructional strategies and the iterative development of curriculum (Kamalov & Gurrib, 2023). Moreover, AI facilitates the

development of adaptive educational platforms that dynamically adjust to individual student needs and preferences, thereby cultivating a more engaging and effective learning experience for all students.

Challenges and limitations of artificial intelligence in pedagogical mentoring

The integration of artificial intelligence into teacher development programs presents both opportunities and inherent limitations that warrant careful consideration. While AI offers the potential to revolutionize pedagogical mentoring through data analysis and pattern recognition, we should acknowledge its limitations, particularly in the relational and human-centered aspects of mentoring. Although AI excels at processing large datasets and automating responses, the nuances of mentoring require emotional intelligence, ethical judgment, and contextual awareness, qualities that remain firmly within the domain of human cognition (Mah & Gross, 2024). As educational institutions increasingly adopt AI-enhanced systems, it becomes imperative to navigate these limitations responsibly, ensuring that technological efficiency does not compromise pedagogical depth or the crucial element of personal connection (Viruel et al., 2025). One of the primary limitations of AI in mentoring lies in its inability to replicate human empathy, which is the very foundation of meaningful interpersonal relationships (Zailuddin et al., 2024). Effective mentoring extends beyond problem diagnosis and performance optimization; it involves fostering trust, providing encouragement, and responding to the emotional and psychological well-being of mentees (Morales-García et al., 2024). AI systems, regardless of their sophistication, lack the capacity for emotional intelligence, making it difficult for them to perceive nonverbal cues, contextual subtleties, or the personal histories that significantly influence a teacher's experiences. The absence of human warmth and intuition makes AI ill-suited to fully replace or replicate the mentor's role in fostering psychological safety and professional confidence, thus, the emotional support required in mentoring must remain a human responsibility, even as AI assists in data-driven coaching (Vistorte et al., 2024).

Addressing the complexities of digital literacy in AI-enhanced mentoring

Digital literacy looks like another challenge in the integration of AI into pedagogical mentoring, necessitating a comprehensive understanding of how educators and students interact with AI technologies. Digital literacy involves not only the technical skills to use digital tools, but also the ability to critically evaluate digital resources and understand their impli-

cations in educational settings. The over-reliance of students on AI technologies can undermine the development of critical thinking and natural intelligence, making it essential for educators to address this issue proactively (Ma et al., 2024). The capacity to assess digital information critically and ethically is vital in today's educational landscape, as educators and students are frequently exposed to AI-generated content. It is concerning that educators and students may overlook or minimize the ethical challenges associated with AI, such as biases in algorithms or the potential for misuse of AI-generated content.

Equipping educators with the digital literacy skills necessary to integrate AI tools responsibly is a requirement, as educators need to be confident in their ability to use generative AI tools effectively and teach students how to use them productively. Educators need comprehensive training and support to utilize AI technologies effectively, which is especially true for experienced educators who may not have had formal training in these technologies. AI's integration into education requires investigation into the issues of the "digital divide" and social inclusion, the risks associated with such innovations, and the opportunities that technologies offer for handling these issues with new approaches (Gentile et al., 2023). In order to foster ethical discernment, strategic deployment, and critical analysis, capacity building that leverages artificial intelligence must go beyond technical training to embrace a holistic approach.

Practical applications and policy recommendations: AI platforms supporting pedagogical mentoring

The increasing availability and sophistication of artificial intelligence technologies present a unique opportunity to enhance teacher development systems. Thoughtfully integrated AI platforms can complement traditional mentoring models, offering scalable, personalized, and data-informed support mechanisms for educators across all experience levels, fostering continuous professional growth and refinement of pedagogical practices (Zhai et al., 2021). AI-driven personalization in education can cater to the unique needs of each student, aiming to level the playing field and foster inclusivity by addressing disparities stemming from socio-economic backgrounds, geographical locations, and inherent biases, which have historically plagued the educational sector (Roshanaei et al., 2023). The application of machine learning algorithms enables educators to gain deeper insights into student progress, facilitating the creation of customized curricula tailored to individual learning requirements, promoting intelligence moderation through data analysis by human tutors and moderators (Nafea, 2018). By analyzing student engagement, performance metrics, and learning behaviors, AI algorithms can discern patterns and trends that might be imperceptible to human educators, allowing for proactive intervention and targeted support (see: Maghsudi et al., 2021). Such data-driven insights empower educators to make

informed decisions about instructional strategies, curriculum design, and resource allocation, optimizing the learning experience for each student.

Several platforms currently in use demonstrate the potential of AI to transform pedagogical mentoring. Edthena, for example, is a video coaching platform that allows teachers to upload classroom recordings for AI-assisted analysis, and the system identifies key instructional moments and provides personalized feedback focused on best teaching practices (Dey, 2025). This platform is particularly effective for asynchronous mentoring, reflective practice, and professional growth tracking, allowing educators to review their teaching practices at their convenience and receive AI-driven feedback on areas for improvement. TeachFX utilizes AI-driven speech recognition to analyze classroom dialogue, providing teachers with detailed reports on student engagement, teacher talk time, and questioning patterns, which supports mentors in promoting interactive and inclusive teaching strategies, proving a more engaging and equitable learning environment (Lin et al., 2023). Sibme combines human mentoring with AI-powered analytics to support collaborative video review, timestamped feedback, and longitudinal tracking of teaching competencies, enabling mentors and mentees to align on specific instructional goals and monitor progress over time (Bulathwela et al., 2021). Loop is an AI-driven feedback platform designed to foster reflective teaching practices through continuous micro-feedback cycles, where teachers can receive anonymized input from students, which the AI aggregates and analyzes to detect patterns in classroom climate, instructional clarity, and student well-being, and empowers mentors to guide educators in fine-tuning their pedagogical approach based on real-time learner perspectives.

These AI-powered platforms not only offer personalized feedback and support but also promote data-driven decision-making in education. AI systems can analyze large datasets and generate insights to understand learners at a granular level. AI technologies can analyze student responses in real-time, providing immediate feedback and insights into student comprehension and learning progress (Onesi-Ozigagun et al., 2024). Automated grading systems powered by AI algorithms can assess and provide feedback on assignments, quizzes, and exams promptly, allowing students to understand their strengths and weaknesses in real-time (Kaledio et al., 2024). However, over-reliance on AI in evaluation might risk standardization and reduce critical pedagogical engagement (Ma et al., 2024). AI-powered learning management systems can aggregate and analyze data from various sources, such as online assignments, tests, and engagement metrics (Amin, 2023). These systems can process student data, derive predictions on the academic performance of those students, and then recommend suitable resources all in an effort to identify those who are at-

risk so that they can be given extra support ("Global Educational Studies Review," 2020). AI driven speech recognition may also be used by instructors to analyze student attitudes and behavior through analysis of student facial expression in the learning process (Saputra et al., 2023). While AI offers numerous advantages for the educational sector, its integration should be approached with caution. Despite the numerous benefits of AI in education, challenges remain, including concerns about data privacy, algorithmic bias, and the need for teacher training (Onesi-Ozigagun et al., 2024).

Integrating AI in pedagogical mentoring: policy recommendations for effective implementation

To harness the transformative potential of AI in pedagogical mentoring, a multifaceted policy approach is essential, addressing ethical considerations, practical implementation, and equitable access. Establishing a robust national or institutional framework is a necessity, in order to guide the ethical and pedagogical utilization of AI in teacher development, ensuring that AI tools are deployed responsibly and in alignment with educational values. This framework should incorporate comprehensive guidelines addressing data privacy protocols, mechanisms for algorithmic transparency to elucidate decision-making processes, and clear lines of accountability to address potential biases or unintended consequences arising from AI implementation, thereby safeguarding the rights and interests of both mentors and mentees (Roshanaei et al., 2023). To ensure the practical efficacy of AI-driven mentoring initiatives, pilot programs should be strategically implemented within teacher training centers and mentor schools, accompanied by rigorous evaluations of their impact on instructional quality, pedagogical practices, and teacher development outcomes. These pilot programs should serve as controlled experiments to assess the effectiveness of AI-based mentoring tools in diverse educational contexts, providing invaluable insights into their strengths, limitations, and areas for refinement (see: "Global Educational Studies Review," 2020). To ensure the successful integration of AI tools, comprehensive and targeted digital training programs must be provided for both mentors and mentees, fostering effective and confident utilization of AI platforms. These training initiatives should extend beyond mere technical proficiency, encompassing pedagogical strategies for leveraging AI to enhance mentoring interactions, facilitate data-driven decision-making, and promote reflective practice among educators (Gentile et al., 2023). Addressing the digital divide is crucial to ensuring equitable access to digital tools and resources, preventing AI-supported mentoring initiatives from exacerbating existing disparities among educators, and guaranteeing that all edu-

cators, regardless of their socioeconomic background or geographic location, have equal opportunities to benefit from AI-enhanced mentoring experiences (see: Roshanaei et al., 2023).

Strategic alliances between educational institutions and edtech developers are essential to tailor AI platforms to specific local educational requirements and contextual nuances, ensuring that these technologies are not only effective but also culturally relevant and responsive to the specific needs of educators (Lin & Brummelen, 2021). Curriculum development, infrastructure considerations, and ethical considerations should be considered when integrating AI into educational practices (Mah & Gross, 2024). Such partnerships should involve collaborative design processes, incorporating input from educators, mentors, and students to ensure that AI tools are aligned with pedagogical goals and effectively address the challenges and opportunities within specific educational settings.

Actively involving educators in the development process ensures that AI tools are relevant and effective, while also enhancing educators' understanding of the research process (McKay & Macomber, 2021). By fostering a collaborative ecosystem between educational institutions and edtech developers, AI-supported mentoring initiatives can be iteratively refined and optimized to maximize their impact on teacher development and student outcomes. Higher education institutions should prioritize the design and execution of comprehensive faculty development initiatives, specifically aimed at equipping educators with the requisite skills and knowledge to seamlessly integrate AI-driven tools and methodologies into their pedagogical practices, ensuring that AI technologies are leveraged effectively to enhance teaching and learning outcomes. This could involve customized workshops, training sessions, and continuous professional development programs tailored to the unique needs and challenges of different disciplines and educational contexts (Su et al., 2025). AI in educational settings must prioritize stakeholders through methodological learning enhancements while also keeping in mind that increasing access to education remains predominantly a political and social issue (Bulathwela et al., 2021; Mello et al., 2023). AI-supported mentoring signifies a synergistic convergence of reflective practice and evidence-based analysis, empowering mentors with actionable data and insights while preserving their indispensable human role in guiding and nurturing the professional growth of educators. This approach allows mentors to leverage data-driven insights to personalize their guidance, address individual mentee needs, and foster a culture of continuous improvement within educational institutions. AI-supported mentoring transcends the limitations of traditional mentoring approaches by providing mentors with real-time data on mentee performance, learning patterns, and areas for improvement, enabling them to tailor their support and

guidance to meet the specific needs of each mentee. By providing personalized guidance, fostering data-driven decision-making, and promoting reflective practice, AI-supported mentoring can enhance the effectiveness of teacher development programs and cultivate a culture of continuous improvement within educational institutions (Lampou, 2023). Therefore, the conscientious and strategic integration of AI into pedagogical mentoring represents a fundamental paradigm shift towards data-informed, personalized, and adaptive teacher development, poised to revolutionize the cultivation of effective educators and ultimately enhance the educational experiences and outcomes of students.

In contemporary educational environments, the implementation of AI-enhanced mentoring is not merely a futuristic aspiration, but a strategic imperative for cultivating resilient, skilled, and responsive educators who are well-equipped to navigate the complexities of modern classrooms and meet the evolving needs of students. AI has the potential to revolutionize how educators teach and students learn by automating administrative activities, creating personalized learning experiences, and offering insightful data analytics (Onesi-Ozigagun et al., 2024; Rizvi, 2023). The integration of AI in education can also optimize administrative functions, allowing educational institutions to manage resources, enroll students, and create schedules more efficiently. This integration not only streamlines operations, but also enables educators to dedicate more time to instructional practices and student engagement, ensuring a more enriching and supportive learning environment. AI platforms offer personalized instruction and feedback based on the needs and progress of each learner, thus revolutionizing the concept of personalized learning (Bayly-Castaneda et al., 2024). AI driven tools give instructors a thorough grasp of how well students are doing, enabling them to develop specialized curricula that address the students' unique needs. As AI technologies continue to evolve and mature, their potential to transform teacher development and enhance educational outcomes will only continue to grow, solidifying their role as a critical component of modern educational ecosystems. The incorporation of AI facilitates the streamlined collection and processing of student feedback, coupled with the nuanced analysis of individual student characteristics, with the result of a more responsive, personalized, and ultimately more effective learning environment (Harry & Sayudin, 2023).

To facilitate the ethical and pedagogical integration of AI into teacher development, a multi-faceted approach is essential, encompassing the establishment of comprehensive ethical frameworks, the implementation of pilot programs, the provision of targeted digital training, the fostering of strategic partnerships, and the promotion of equitable access to digital tools. By establishing a national framework, piloting AI-based tools, providing digital training,

partnerships, and promoting equitable access, educational institutions can harness the power of AI to enhance teacher development and improve student outcomes (Onesi-Ozigagun et al., 2024). A crucial step involves developing a comprehensive national or institutional framework that establishes clear ethical guidelines and pedagogical standards for the responsible and equitable utilization of AI in teacher development initiatives across diverse educational settings. To effectively harness the potential of AI in education, we should cultivate robust partnerships between educational institutions and edtech developers, with the result of collaborative efforts to adapt and refine AI platforms to align with the unique needs and contexts of local educational environments. It is essential to promote equitable access to digital tools and resources, ensuring that AI-supported mentoring initiatives do not inadvertently exacerbate the digital divide among educators but instead contribute to a more inclusive and equitable educational landscape. For the use of AI in educational settings, teachers should receive targeted training in digital literacy to guarantee that they can use AI platforms with confidence and effectiveness (Ma et al., 2024).

Further empirical research is a desiderate, to rigorously evaluate and compare the efficacy of AI-enhanced learning environments with traditional face-to-face and blended learning modalities, enabling a comprehensive understanding of their respective strengths, limitations, and suitability for diverse educational contexts. The ongoing evolution of AI technologies necessitates continuous professional development for educators, equipping them with the knowledge and skills required to effectively integrate AI tools into their pedagogical practices, along with a critical awareness of the ethical considerations and potential biases inherent in AI algorithms. Emphasis should be placed on the importance of cultivating educators' proficiency in responsible AI practices, ensuring that they possess the capacity to critically evaluate AI-generated content, address algorithmic biases, and uphold ethical standards in their utilization of AI tools within academic settings (Nadim & Fuccio, 2025). The main goal of AI is to empower people, not to replace them, therefore all stakeholders should consider trade-offs of AI technologies before implementing them in the real world to ensure proper policy creation and implementation (Ojha et al., 2023). When these difficulties are resolved and AI is used responsibly, it can greatly improve education by giving teachers and students more support and by encouraging lifelong learning.

Conclusion

The integration of artificial intelligence into pedagogical mentoring is not a question of replacement, but one of reinforcement and synergy. While AI offers powerful tools for analysis, feedback, and personalization, it cannot

replicate the empathy, ethical discernment, and context-awareness that human mentors provide. Together, AI and mentoring can transform teacher development into a more dynamic, data-informed, and emotionally responsive process. Human mentors bring relational depth and professional wisdom, while AI enhances decision-making through real-time analytics and targeted interventions. This combination cultivates more effective, confident, and reflective educators. For successful implementation, it is essential to ensure equitable access, address digital literacy, and uphold ethical standards. Educational institutions must provide training, build cross-sector partnerships, and foster a culture of lifelong learning. The future of teacher development lies in a balanced alliance between human insight and machine intelligence – empowering educators to navigate the complex demands of modern classrooms with agility, compassion, and purpose.

References

Amin, M. Y. M. (2023). AI and Chat GPT in Language Teaching: Enhancing EFL Classroom Support and Transforming Assessment Techniques. *International Journal of Higher Education Pedagogies*, 4(4), 1. Doi: https://doi.org/10.33422/ijhep.v4i4.554

Bayly-Castaneda, K., Ramirez-Montoya, M.-S., & Morita-Alexander, A. (2024). Crafting personalized learning paths with AI for lifelong learning: a systematic literature review. *Frontiers in Education*, 9. Doi: https://doi.org/10.3389/feduc.2024.1424386

Bhebhe, S. (2022). Mentoring pre-service teachers in situated learning: A case study of a Zimbabwean teacher training college. *Zenodo* (CERN European Organization for Nuclear Research). Doi: https://doi.org/10.5281/zenodo.7299060

Bradbury, L. (2010). Educative mentoring: Promoting reform-based science teaching through mentoring relationships. *Science Education*, 94(6), 1049. Doi: https://doi.org/10.1002/sce.20393

Bulathwela, S., Pérez-Ortiz, M., Holloway, C., & Shawe-Taylor, J. (2021). Could AI Democratise Education? Socio-Technical Imaginaries of an EdTech Revolution. *arXiv* (Cornell University). Doi: https://doi.org/10.48550/arxiv.2112.02034

Demartini, C. G., Sciascia, L., Bosso, A., & Manuri, F. (2024). Artificial Intelligence Bringing Improvements to Adaptive Learning in Education: A Case Study. *Sustainability,* 16(3), 1347. Doi: https://doi.org/10.3390/su16031347

Dey, D. (2025). Enhancing Educational Tools Through Artificial Intelligence in *Perspective of Need of AI*. Doi: https://doi.org/10.2139/ssrn.5031275

Ellikkal, A., & Rajamohan, S. (2024). AI-enabled personalized learning: empowering management students for improving engagement and academic performance. *Vilakshan – XIMB Journal of Management*. Doi: https://doi.org/10.1108/xjm-02-2024-0023

Enerson, D. M. (2001). Mentoring as Metaphor: An Opportunity for Innovation and Renewal. *New Directions for Teaching and Learning,* 2001(85), 7. Doi: https://doi.org/10.1002/tl.1

Gentile, M., Città, G., Perna, S., & Allegra, M. (2023). Do we still need teachers? Navigating the paradigm shift of the teacher's role in the AI era. *Frontiers in Education*, 8. Doi: https://doi.org/10.3389/feduc.2023.1161777

Global Educational Studies Review. (2020). *In Global Educational Studies Review*. Doi: https://doi.org/10.31703/gesr

Goldberg, D. E. (2018). On becoming a reflective practitioner. *Proceedings of the Genetic and Evolutionary Computation Conference,* 4. Doi: https://doi.org/10.1145/3205455.3219816

Haensly, P. A., & Parsons, J. L. (1993). Creative, Intellectual, and Psychosocial Development through Mentorship. *Youth & Society*, 25(2), 202. Doi: https://doi.org/10.1177/0044118x93025002002

Harry, A., & Sayudin, S. (2023). Role of AI in Education. *Interdiciplinary Journal and Hummanity (INJURITY),* 2(3), 260. Doi: https://doi.org/10.58631/injurity.v2i3.52

Jian, M. J. K. O. (2023). Personalized learning through AI. *Advances in Engineering Innovation,* 5(1), 16. Doi: https://doi.org/10.54254/2977-3903/5/2023039

Kaledio, P., Robert, A., & Frank, L. A. (2024). The Impact of Artificial Intelligence on Students' Learning Experience. *SSRN Electronic Journal*. Doi: https://doi.org/10.2139/ssrn.4716747

Kamalov, F., & Gurrib, I. (2023). New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution. *arXiv* (Cornell University). Doi: https://doi.org/10.48550/arxiv.2305.18303

Lampou, R. (2023). The Integration of Artificial Intelligence in Education: Opportunities and Challenges. *Review of Artificial Intelligence in Education,* 4. Doi: https://doi.org/10.37497/rev.artif.intell.educ.v4i00.15

Lin, C.-C., Huang, A. Y. Q., & Lu, O. H. T. (2023). Artificial intelligence in intelligent tutoring systems toward sustainable education: a systematic review [Review of Artificial intelligence in intelligent tutoring systems toward sustainable education:

a systematic review]. *Smart Learning Environments,* 10(1). Springer Nature. Doi: https://doi.org/10.1186/s40561-023-00260-y

Lin, P., & Brummelen, J. V. (2021). Engaging Teachers to Co-Design Integrated AI Curriculum for K-12 Classrooms. 1. Doi: https://doi.org/10.1145/3411764.3445377

Luan, H., Géczy, P., Lai, H., Gobert, J. D., Yang, S. J. H., Ogata, H., Baltes, J., Guerra, R. da S., Li, P., & Tsai, C. (2020). Challenges and Future Directions of Big Data and Artificial Intelligence in Education [Review of Challenges and Future Directions of Big Data and Artificial Intelligence in Education]. *Frontiers in Psychology,* 11. Frontiers Media. Doi: https://doi.org/10.3389/fpsyg.2020.580820

Ma, K., Zhang, Y., & Hui, B.-H. (2024). How Does AI Affect College? The Impact of AI Usage in College Teaching on Students' Innovative Behavior and Well-Being. *Behavioral Sciences,* 14(12), 1223. Doi: https://doi.org/10.3390/bs14121223

Maghsudi, S., Lan, A., Xu, J., & Schaar, M. van der. (2021). Personalized Education in the Artificial Intelligence Era: What to Expect Next. *IEEE Signal Processing Magazine,* 38(3), 37. Doi: https://doi.org/10.1109/msp.2021.3055032

Mah, D.-K., & Gross, N. (2024). Artificial intelligence in higher education: exploring faculty use, self-efficacy, distinct profiles, and professional development needs. *International Journal of Educational Technology in Higher Education,* 21(1). Doi: https://doi.org/10.1186/s41239-024-00490-1

McKay, C., & Macomber, G. (2021). The Importance of Relationships in Education: Reflections of Current Educators. *Journal of Education,* 203(4), 751. Doi: https://doi.org/10.1177/0022057421057044

Mello, R. F., Freitas, E., Pereira, F. D., Cabral, L., Tedesco, P., & Ramalho, G. (2023). Education in the age of Generative AI: Context and Recent Developments. *arXiv* (Cornell University). Doi: https://doi.org/10.48550/arxiv.2309.12332

Mena-Guacas, A. F., Rodríguez, J. A. U., Trujillo, D. M. S., Galán, J. G., & Menéses, E. L. (2023). Collaborative learning and skill development for educational growth of artificial intelligence: A systematic review [Review of Collaborative learning and skill development for educational growth of artificial intelligence: A systematic review]. *Contemporary Educational Technology,* 15(3). Doi: https://doi.org/10.30935/cedtech/13123

Morales-García, W. C., Sairitupa-Sanchez, L. Z., Morales-García, S. B., & Morales-García, M. (2024). Development and validation of a scale for dependence on artificial intelligence in university students. *Frontiers in Education,* 9. Doi: https://doi.org/10.3389/feduc.2024.1323898

Nadim, M. A., & Fuccio, R. D. (2025). Unveiling the Potential: Artificial Intelligence's Negative Impact on Teaching and Research Considering Ethics in Higher Education. *European Journal of Education,* 60(1). Doi: https://doi.org/10.1111/ejed.12929

Nafea, I. (2018). Machine Learning in Educational Technology. *In InTech eBooks*. Doi: https://doi.org/10.5772/intechopen.72906

OECD Digital Education Outlook 2021. (2021*). In Digital education outlook. Organization for Economic Cooperation and Development*. Doi: https://doi.org/10.1787/589b283f-en

Ojha, S., Narendra, A., Mohapatra, S., & Misra, I. (2023). From Robots to Books: An Introduction to Smart Applications of AI in Education (AIEd). *arXiv* (Cornell University). Doi: https://doi.org/10.48550/arxiv.2301.10026

Ojo, O. A., Adu, E. O., & Adu, E. O. (2017). School Experience: Institutions' Expectations from Pre-service Teachers. *The Anthropologist,* 29(1), 19. Doi: https://doi.org/10.1080/09720073.2017.1335825

Onesi-Ozigagun, O., Ololade, Y. J., Eyo-Udo, N. L., & Ogundipe, D. O. (2024). Revolutionizing Education through AI: A Comprehensive Review of Enhancing Learning Experiences. *International Journal of Applied Research in Social Sciences,* 6(4), 589. Fair East Publishers. Doi: https://doi.org/10.51594/ijarss.v6i4.1011

Pahi, K., Hawlader, S., Hicks, E., Zaman, A., & Phan, V. (2024). Enhancing active learning through collaboration between human teachers and generative AI. *Computers and Education Open,* 6, 100183. Doi: https://doi.org/10.1016/j.caeo.2024.100183

Rizvi, M. (2023). Investigating AI-Powered Tutoring Systems that Adapt to Individual Student Needs, Providing Personalized Guidance and Assessments. *The Eurasia Proceedings of Educational and Social Sciences,* 31, 67. Doi: https://doi.org/10.55549/epess.1381518

Rockoff, J. E. (2008). Does Mentoring Reduce Turnover and Improve Skills of New Employees? Evidence from Teachers in New York City. *SSRN Electronic Journal*. Doi: https://doi.org/10.2139/ssrn.1147662

Roméro, M., Heiser, L., Lepage, A., Gagnebien, A., Bonjour, A.,

Lagarrigue, A., Palaude, A., Boulord, C., Gagneur, C.-A., Mercier, C., Caucheteux, C., Guidoni-Stoltz, D., Tressols, F., Henry, J., Alexandre, F., Céci, J.-F., Camponovo, J., Fouché, L., Métral, J.-F., … Borgne, Y. L. (2023). Teaching and learning in the age of artificial intelligence. *arXiv* (Cornell University). Doi: https://doi.org/10.48550/arxiv.2303.06956

Roshanaei, M., Olivares, H., & Lopez, R. R. (2023). Harnessing AI to Foster Equity in Education: Opportunities, Challenges, and Emerging Strategies. *Journal of Intelligent Learning Systems and Applications,* 15(4), 123. Doi: https://doi.org/10.4236/jilsa.2023.154009

Saputra, I., Astuti, M., Sayuti, M., & Kusumastuti, D. (2023). Integration of Artificial Intelligence in Education: Opportunities, Challenges, Threats and Obstacles. A Literature Review. *Indonesian Journal of Computer Science,* 12(4). Doi: https://doi.org/10.33022/ijcs.v12i4.3266

Shaffer, D. W., Nash, P., & Ruis, A. R. (2015). Technology and the New Professionalization of Teaching. *Teachers College Record The Voice of Scholarship in Education,* 117(12), 1. Doi: https://doi.org/10.1177/016146811511701205

Su, M., Ma, L., Zhang, D., Yunusa-Kaltungo, A., & Cheung, C. (2025). Exploring Benefits and Concerns of Incorporating Digital Tools into Engineering Education. *European Journal of Education and Pedagogy,* 6(1), 45. Doi: https://doi.org/10.24018/ejedu.2025.6.1.909

Tanjung, F. Z., Musthafa, B., & Wirza, Y. (2021). Voice of EFL mentor teachers: Mentorship for mutual professional development. *Deleted Journal,* 8(3), 986. Doi: https://doi.org/10.24815/siele.v8i3.20401

Viruel, S. R., Rivas, E. S., & Ruiz-Palmero, J. (2025). The Role of Artificial Intelligence in Project-Based Learning: Teacher Perceptions and Pedagogical Implications. *Education Sciences,* 15(2), 150. Doi: https://doi.org/10.3390/educsci15020150

Vistorte, A. O. R., Deroncele-Acosta, Á., Ayala, J. L. M., Barrasa, Á., López-Granero, C., & Martí-González, M. (2024). Integrating artificial intelligence to assess emotions in learning environments: a systematic literature review. *Frontiers in Psychology,* 15. Doi: https://doi.org/10.3389/fpsyg.2024.1387089

Zailuddin, M. F. N. O., Harun, N. A. N., Rahim, H. A. A., Kamaruzaman, A. F., Berahim, M. H., Harun, M. H., & Ibrahim, Y. (2024). Redefining creative education: a case study analysis of AI in design courses. *Journal of Research in Innovative Teaching*

& Learning, 17(2), 282. Doi: https://doi.org/10.1108/jrit-01-2024-0019

Zhai, X., Chu, X., Chai, C. S., Jong, M. S., Starčič, A. I., Spector, M., Liu, J., Jing, Y., & Li, Y. (2021). A Review of Artificial Intelligence (AI) in Education from 2010 to 2020 [Review of A Review of Artificial Intelligence (AI) in *Education from 2010 to 2020*]. *Complexity,* 2021(1). Hindawi Publishing Corporation. Doi: https://doi.org/10.1155/2021/8812542

Zhou, J., Zhang, J., & Li, H. (2023). Exploring the Use of Artificial Intelligence in Teaching Management and Evaluation Based on Citation Space Analysis. *Journal of Education and Educational Research,* 3(2), 42. Doi: https://doi.org/10.54097/jeer.v3i2.9014

-