eISSN: 2774-2180, pISSN: 2774-2199
https://journal.unigha.ac.id/index.php/SemNas

NAVIGATING PEDAGOGICAL EVOLUTION: THE IMPLICATION OF GENERATIVE AI ON THE REINVENTION OF TEACHER EDUCATION

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Abstract

With the proliferation of artificial intelligence (AI), significant disruptions manifest in various sectors, including education. This paper focuses on a cutting-edge subset of AI known as Generative AI, its implications on the teaching profession, and the consequential reformations required in teacher education programs. Under the current research landscape, scholars have touched upon AI's impact on teaching. Nevertheless, a dearth of comprehensive exploration concerning the specific effect of Generative AI on teachers' roles and subsequent teacher education transformation persists. The problem addressed here revolves around the challenge of preparing future teachers for classrooms by gradually integrating Generative AI. This work endeavours to fill this gap by arguing that a pedagogical revolution is imminent. It posits that Generative AI, with its capabilities for personalised learning and content generation, facilitates the evolution of teachers from content deliverers to enablers of student-centric learning. This necessitates a drastic paradigm shift in teacher education. This argumentative review and theoretical analysis employ a critical lens to examine existing literature and elucidate the emergent role of teachers. Findings suggest a novel conceptual framework for transforming teacher education, emphasising the importance of AI-tool integration, ethical considerations, interpretation of AI-generated data, and promoting learner-centric environments. Significantly, these insights open new doors in higher education research, underscoring the need to reconfigure teacher training to ensure an effective pedagogical transition in this AI-imbued era. The teacher education programs of tomorrow should be designed with an understanding of today's digital revolution, striving for a balance between technology and the human element in education.

Keyword: *Argumentative Review, Artificial Intelligence, Generative AI, Pedagogical Evolution, Teacher Education*

Abstrak

Dengan meluasnya kecerdasan buatan (AI), gangguan signifikan muncul di berbagai sektor, termasuk pendidikan. Makalah ini berfokus pada subset AI yang mutakhir, dikenal sebagai Generative AI, implikasinya terhadap profesi pengajaran, dan reformasi yang diperlukan dalam program pendidikan guru. Dalam lanskap penelitian saat ini, para ilmuwan telah menyinggung dampak AI terhadap pengajaran. Namun demikian, kekurangan eksplorasi komprehensif mengenai pengaruh spesifik Generative AI terhadap peran guru dan transformasi pendidikan guru berikutnya masih tetap ada. Permasalahan yang diangkat di sini berkisar pada tantangan dalam mempersiapkan guru masa depan untuk kelas dengan cara mengintegrasikan Generative AI secara bertahap. Karya ini berupaya untuk mengisi celah ini dengan berargumen bahwa revolusi pedagogis segera datang. Makalah ini berposisi bahwa Generative AI, dengan kemampuannya untuk pembelajaran personal dan generasi konten, memfasilitasi evolusi guru dari pengantar konten menjadi fasilitator pembelajaran yang berpusat pada siswa. Hal ini memerlukan pergeseran paradigma yang drastis dalam pendidikan guru. Tinjauan argumentatif dan analisis teoretis ini menggunakan lensa kritis untuk memeriksa literatur yang ada dan menjelaskan peran emergen guru. Temuan menunjukkan kerangka konseptual baru untuk mengubah pendidikan guru, dengan menekankan pentingnya integrasi alat AI, pertimbangan etis, interpretasi data yang dihasilkan AI, dan promosi lingkungan yang berpusat pada pelajar. Secara signifikan, wawasan ini membuka pintu baru dalam penelitian pendidikan tinggi, menekankan kebutuhan untuk mengkonfigurasi ulang pelatihan guru untuk memastikan transisi pedagogis yang efektif dalam era yang dipenuhi AI ini. Program pendidikan guru masa depan seharusnya dirancang dengan pemahaman tentang revolusi digital saat ini, berusaha mencapai keseimbangan antara teknologi dan elemen manusia dalam pendidikan.

Kata kunci: *Tinjauan Argumentatif, Kecerdasan Buatan, Generative AI, Evolusi Pedagogis, Pendidikan Guru*

INTRODUCTION

eISSN: 2774-2180, pISSN: 2774-2199
https://journal.unigha.ac.id/index.php/SemNas

A. Contextualisation of AI's advent in educational settings

Artificial intelligence (AI) has prompted a new era in education (Baskara, 2023; Baskara & Mukarto, 2023; Holmes et al., 2023; Nemorin et al., 2023). Classrooms, once considered isolated from technological advancement, now witness an influx of AI-enabled teaching and learning tools (Dimitriadou & Lanitis, 2023; Gašević et al., 2023; Ji, Han, & Ko, 2023). These innovations not only simplify administrative tasks but also foster an enriched, personalised learning environment, promising a significant shift in educational dynamics (De la Vall & Araya, 2023; Dogan et al., 2023; Firat, 2023). As AI further permeates the pedagogical landscape, it is crucial to acknowledge the profound implications for teachers and students alike (Chiu et al., 2023; Kumar, 2023; Wang et al., 2023). Education stakeholders should recognise that these technological transformations are not mere add-ons to existing practices but catalysts for fundamentally reshaping the educational paradigm (Bozkurt, 2023; Khan & Lulwani, 2023; Pal, 2023). Moreover, AI's advent in educational settings signifies a departure from traditional teaching methods (Zawacki-Richter et al., 2019). With AI augmenting or replacing specific tasks traditionally performed by educators, a complex interplay emerges between technology, teacher roles, and the teaching process (Schwartz et al., 2016). This shift requires a meticulous examination to navigate the rapidly evolving pedagogical landscape (Brynjolfsson & McAfee, 2014).

B. Generative AI - a focus on its influence in the education sector

Generative AI, a sophisticated subset of AI, stands at the forefront of this educational revolution (Goodfellow et al., 2016). By synthesising original content, it advances beyond reactive applications of AI, such as those commonly found in automated grading systems or adaptive learning platforms. Generative AI, in effect, transforms teaching and learning dynamics by allowing personalised and adaptive learning experiences at scale (Zhang et al., 2018). Notably, Generative AI expands the horizons of pedagogical innovation. Moving beyond merely reactive tasks fosters creative exploration in teaching and learning, inspiring a reimagination of conventional pedagogical practices (Bessen, 2018). With Generative AI, it is feasible to envisage a future where technology enhances humanistic elements in education, promoting individualised learning pathways rather than homogenised instruction. However, alongside Generative AI opportunities, educators face novel challenges (Bostrom & Yudkowsky, 2014). These include redefining their roles in a setting where AI can generate educational content and facilitate learning, understanding and addressing the ethical implications of AI use (Mittelstadt et al., 2016), and preparing learners for an AI-integrated future (Rainie & Anderson, 2017).

eISSN: 2774-2180, pISSN: 2774-2199
https://journal.unigha.ac.id/index.php/SemNas

C. Highlighting the question: How does Generative AI impact the role of teachers, and what modifications are requisite in teacher education programs?

This examination elucidates a pressing question: Given Generative AI's transformative potential, how does it impact teachers' roles, and how should teacher education programs evolve in response (Goertzel et al., 2014)? An in-depth exploration of this question is crucial, as teacher education is the linchpin in preparing future educators for an AI-integrated educational landscape (Darling-Hammond, 2017). With Generative AI revolutionising teaching and learning processes, a paradigm shift in teacher education programs becomes indispensable. As teaching transforms from a task of content delivery to facilitating AI-mediated, student-centric learning, teacher education must evolve to encompass these changes (Reich & Ruipérez-Valiente, 2019). Given this backdrop, the study aims to unravel the interplay between Generative AI and the transformation of teacher roles while concurrently elucidating the implications for teacher education (Cope & Kalantzis, 2017). This analysis intends to furnish valuable insights for educators, policy-makers, and academia, guiding them through this period of pedagogical metamorphosis (Fullan, 2015).

METHODOLOGY

A. Rationale for selecting an argumentative review approach

This analysis chose the argumentative review approach as the principal methodological strategy for several compelling reasons. First, it allows for a rigorous examination of the wealth of scholarly opinions concerning Generative AI's impact on the role of teachers, thus enabling a comprehensive understanding of the topic's nuances (Grant & Booth, 2009). An argumentative review approach facilitates a critical analysis, synthesising contrasting perspectives and revealing gaps in existing knowledge (Onwuegbuzie et al., 2012). Second, this approach invites a healthy intellectual debate (Jensen & Allen, 1996). Analysing conflicting viewpoints fosters a deeper understanding of the diverse ways Generative AI impacts the teaching profession and necessitates changes in teacher education programs (Noblit & Hare, 1988). Hence, the argumentative review approach emerges as an ideal strategy to navigate the complexity of this study's primary question (Machi & McEvoy, 2021).

B. Procedure for a systematic review of existing literature

The systematic review of existing literature is the bedrock of this argumentative review. A robust procedure ensures comprehensiveness and methodological rigour (Petticrew & Roberts, 2008). Initially, relevant databases were exhaustively searched using keywords associated with Generative AI, teacher roles, and teacher education (Booth et al., 2012). Following this, inclusion and exclusion criteria were applied to screen potential sources and ensure their relevance to the research question (Moher et al., 2009). Subsequently, a meticulous thematic analysis was conducted (Braun &

eISSN: 2774-2180, pISSN: 2774-2199
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Clarke, 2006). Emerging themes from the selected literature helped understand the multifaceted impact of Generative AI on teaching and learning processes and the associated transformations required in teacher education (Thomas & Harden, 2008). This systematic approach to literature review ensures a comprehensive, unbiased exploration of the topic (Khan et al., 2003).

C. Outline of the theoretical analysis - from evolving teacher roles to reimagining teacher education

A theoretical analysis supports this research endeavour, providing a conceptual scaffold to comprehend the implications of Generative AI on the role of teachers and the necessary reforms in teacher education (Creswell & Creswell, 2017). This analysis links abstract theory with concrete educational practice, illuminating the intricate dynamics between technological advancements and pedagogical transformation (Cohen et al., 2011). First, the analysis explores the evolving role of teachers within an AI-integrated educational landscape (Shulman, 1991). It theorises how teachers might transition from primary content providers to facilitators in student-centric, AI-enhanced learning environments (Darling-Hammond et al., 2017). It further considers the ethical implications of AI use and how teachers might navigate these ethical landscapes (Biesta, 2015). Second, the theoretical analysis addresses the consequent modifications in teacher education programs (Zeichner, 2012). It posits a conceptual framework for redesigning teacher education curricula, aligning them with the exigencies of an AI-integrated educational landscape (Fullan & Hargreaves, 2016). In so doing, it illuminates a path for teacher education to evolve with the rapid advances of Generative AI.

RESULTS

A. Evidence of teacher roles transforming under Generative AI's influence

Embarking on this journey of literature exploration, we uncover a tapestry of evidentiary threads pointing towards a profound influence of Generative AI on the role of teachers. One of the emerging themes centres around the shift in teachers' functions from being the primary sources of knowledge to becoming facilitators of learning (Fadel et al., 2019). This transition owes its roots to the innate capability of Generative AI to produce educational content autonomously, significantly reducing teachers' traditional burden of content creation and delivery (Luckin et al., 2016).

Further, as one delves deeper into the technological landscape of education, another transformation unravels the metamorphosis of teachers into learning engineers (Goodyear & Retalis, 2010). This new role comes to the fore as Generative AI brings to the table adaptive learning capabilities, which tailor learning experiences to the unique needs of individual students (Woolf, 2010). Consequently, teachers find themselves in a position where they must understand, oversee, and optimise these

eISSN: 2774-2180, pISSN: 2774-2199
https://journal.unigha.ac.id/index.php/SemNas

personalised learning processes, requiring them to adopt a more technologically nuanced role (Bulger, 2016).

As teachers transition into these complex roles, their responsibilities inevitably expand to encompass a comprehensive understanding of AI tools, an astute interpretation of data, and the strategic deployment of AI to elevate learning outcomes (Herodotou et al., 2019). Hence, they foster and engineer learning environments, ensuring an optimal blend of technology and pedagogy.

As the influence of AI in classrooms continues to rise, an additional layer of complexity surfaces, encapsulating the ethical aspects associated with using such advanced technologies (Mittelstadt et al., 2016). With AI's growing ubiquity, the role of teachers extends beyond pedagogical and learning engineering facets to include the stewardship of ethical AI usage (Floridi & Taddeo, 2016). This encompasses a range of concerns, such as privacy, data security, and the potential for algorithmic bias (Brey, 2012). As we tread the path of AI integration in education, teachers find themselves at the helm, navigating these concerns and ensuring an ethically sound educational landscape (Zuboff, 2019).

B. Manifestations of these role changes in real-world classrooms

Evidence of the transformation of teacher roles is not confined to academic discourses or theoretical musings; it is becoming an observable reality in classrooms worldwide (Selwyn, 2019). The infiltration of AI-powered tools in educational settings prompts an undeniable diversification of teachers' functions (Bulger, 2016). As classrooms transform into dynamic hubs of personalised education, teachers don diverse hats, reflecting the shifts caused by AI integration.

Many real-world instances surface where teachers, capitalising on AI, shift from broad-spectrum educators to mentors, intricately crafting individual learning paths. They leverage AI's propensity for personalisation to deliver instruction that resonates with each student's learning style, pace, and aptitude. As a result, teachers transition from mass educators to personal mentors, adeptly guiding students along their unique academic journeys.

In contrast, the ethical implications accompanying AI's integration in classrooms are pressing teachers to evolve into ethical stewards (Brey, 2012). In this new capacity, they confront the intersection of AI's potential and ethical dilemmas (Floridi & Cowls, 2022). With AI's robust capabilities comes the task of judicious use, balancing enhancing learning experiences and respecting individual privacy (Mittelstadt et al., 2016).

Teachers increasingly find themselves as the negotiators in the tug-of-war between personalised learning and privacy concerns (Zuboff, 2019). With every student's data becoming a crucial part of AI's function, teachers must judiciously mediate between

eISSN: 2774-2180, pISSN: 2774-2199
https://journal.unigha.ac.id/index.php/SemNas

optimising AI's benefits and safeguarding students' privacy (Crawford & Schultz, 2014). This critical role underscores the expanded boundaries of teacher responsibilities in AI-integrated classrooms, signifying a compelling facet of this profound transformation (Pasquale, 2015).

C. Identified gaps in current teacher education, as revealed through the argumentative review

An argumentative review, dissecting the currents of teacher education reveals disconcerting gaps in the existing fabric of such programs (Cochran-Smith & Zeichner, 2009). Current educational structures appear to be struggling to accommodate the rapid integration of AI into teaching (Biesta, 2015). A conspicuous chasm exists between traditional teaching skills, which continue to be the focus of most educational programs, and the increasingly AI-driven environment of modern classrooms.

Primarily, the inadequacy of teacher education programs is seen in their inability to aptly prepare future educators for their morphing roles in AI-integrated classrooms (Darling-Hammond et al., 2017). With AI's adoption, teaching evolves beyond conventional pedagogy into a multifaceted profession necessitating an understanding of AI's capabilities, strategic implementation, and ethical implications (Herodotou et al., 2019). Existing programs, regrettably, offer little comprehensive training on leveraging AI to augment pedagogical practice (Goodyear & Retalis, 2010).

Moreover, the issue of ethical stewardship looms large, casting long shadows on the current landscape of teacher education (Brey, 2012). In the evolving educational milieu, ethical considerations surrounding AI use in classrooms are gaining paramount importance (Floridi & Taddeo, 2016). Nevertheless, our education programs seem to falter, failing to accord this aspect the attention it deserves (Zuboff, 2019). This omission is particularly alarming, considering the crucial role of teachers as ethical mediators in the AI-infused teaching-learning ecosystem (Mittelstadt et al., 2016).

Lastly, a disconnect emerges between the lightning-fast advancement of AI in education and the relatively sluggish evolution of teacher education programs. In a world where technology is constantly in flux, teacher education seems to lag, struggling to synchronise its pace with AI advancements (Bulger, 2016). This situation underscores the need for teacher education to quicken its steps, revising its curricula to mirror the realities of the modern, AI-enhanced classroom.

DISCUSSION

A. Elaboration on results and their implications for teacher education

Findings from the argumentative review present an intriguing pattern, pushing to the forefront a vital realisation - the encroachment of Generative AI into the educational

eISSN: 2774-2180, pISSN: 2774-2199
https://journal.unigha.ac.id/index.php/SemNas

arena ushers in a need for reevaluation, not only of traditional teacher roles but also of the corresponding metamorphosis in teacher education (Fadel et al., 2019). With AI assuming control over routine instructional tasks, educators find themselves nudged into a position where their emphasis must shift. Their role transforms from mere conveyers of knowledge to catalysts, sparking the flame of their students' critical thinking and problem-solving skills (Luckin et al., 2016).

Critical thinking and problem-solving competencies form the essence of what distinguishes human intellect from AI, no matter the latter's sophistication. With all its computational power and efficiency, AI finds itself at a loss when it comes to fostering these quintessentially human skills (Woolf, 2010). In the grand chessboard of education, these abilities are the king - irreplaceable and essential. Therefore, one cannot overstate the need for teacher education to pivot toward nurturing these indispensable skills in aspiring educators (Goodyear & Retalis, 2010).

Similarly, as educators transition into the role of learning engineers, another lacuna in our education system comes to light - the urgent need for teacher education to equip its wards with a robust foundation in data literacy and a comprehensive understanding of AI tools (Herodotou et al., 2019). This shift marks a revolution in the traditional teaching paradigm, making data literacy an essential skill akin to literacy and numeracy in the previous century (Bulger, 2016).

In light of AI's increasing footprint in classrooms, the ability to comprehend and interpret AI-generated data forms an integral part of effective teaching. Teachers of the future must be able to weave the thread of data into a coherent narrative, guiding their pedagogical decisions.

Preparing teachers to make enlightened pedagogical choices based on data analytics is a pivotal objective for contemporary teacher education. This new challenge requires us to rethink our existing structures and revamp our curricula, making room for new skills without compromising what makes a great teacher - the ability to inspire and guide (Biesta, 2015).

B. Argument for the reformation of teacher education curricula to accommodate the influence of Generative AI

As our research findings indicate, the emergent, ever-evolving landscape of teacher roles within AI-integrated classrooms presses forth a compelling case for a comprehensive reformation of teacher education curricula. Traditional models of teacher education, which have hitherto emphasised content mastery and pedagogical strategies, seem to be losing relevance in the face of these technological advancements (Darling-Hammond et al., 2017). These conventional approaches appear inadequate in preparing teachers for the AI-dominated classrooms of the future (Cochran-Smith & Zeichner, 2009).

eISSN: 2774-2180, pISSN: 2774-2199
https://journal.unigha.ac.id/index.php/SemNas

Instead, the exigencies of the times demand a paradigm shift in our perception of teacher education - a shift towards a more holistic, technology-infused model of teacher preparation (Bulger, 2016). Such a model would not only imbibe the essential tenets of traditional education but also intertwine these elements with a firm grounding in advanced technology (Goodyear & Retalis, 2010). An approach that fails to acknowledge and incorporate AI's profound influence on contemporary pedagogical practices will likely fail to produce effective educators for the 21st-century classroom (Herodotou et al., 2019).

Significantly, this paradigm shift necessitates a substantial overhaul of current curricula. As our traditional curricular content is reexamined, it becomes evident that integrating new areas of knowledge, such as AI literacy, data interpretation skills, and ethical considerations related to AI usage, is paramount (Brey, 2012). These elements should not be tacked onto existing curricula as an afterthought but rather interwoven into the fabric of teacher education, reflecting the symbiotic relationship between technology and pedagogy in today's classrooms (Floridi & Taddeo, 2016).

Moreover, the future-oriented teacher education model must foster a lifelong learning mindset among aspiring educators (Zuboff, 2019). With the rapid pace at which technology evolves, educators must constantly update their knowledge and skills, aligning their teaching practices with the latest developments in AI and other ed-tech tools (Pasquale, 2015). Teacher education programs, hence, need to instil in their students an intrinsic motivation for continuous professional development, enabling them to stay abreast of technological advances and seamlessly integrate them into their teaching (Mittelstadt et al., 2016).

Teacher education stands on the precipice of radical transformation (Selwyn, 2019). These programs must adapt and evolve in response to technological advancements, ensuring they continue fulfilling their purpose in an increasingly AI-dominated educational landscape. The next generation of educators must be ready to navigate this landscape and shape it, contributing to a more effective, inclusive, and inspiring future of education.

C. Ethical considerations when incorporating AI tools in teaching and how these can be addressed in teacher education

Ethical considerations arising from the incorporation of AI in classrooms command noteworthy discussion and attention, underscored by their criticality in modern educational discourse (Floridi & Cowls, 2022). Data privacy, security, and algorithmic bias are pressing concerns (Crawford & Schultz, 2014). Their profound implications for the rights and welfare of students necessitate a conscientious examination and understanding of these complexities (Mittelstadt et al., 2016). As these dilemmas arise, teachers, the frontline users of AI in educational contexts, find their roles extending to include ethical mediation and digital stewardship (Brey, 2012).

eISSN: 2774-2180, pISSN: 2774-2199
https://journal.unigha.ac.id/index.php/SemNas

Consequently, the onus falls on teacher education to illuminate these ethical challenges to its aspirants (Floridi & Taddeo, 2016). A substantial focus must be given to the potential pitfalls of AI usage, sensitising educators to these nuances and equipping them with practical strategies to negotiate the same (Zuboff, 2019). A pedagogical structure that integrates ethical considerations into its foundational principles becomes instrumental in providing educators with the intellectual tools they need to navigate this complex landscape (Pasquale, 2015). The objective should not merely be the acquisition of AI literacy but developing an ethical literacy that aids in the discerning application of AI tools (Bulger, 2016).

To this end, ethics courses, case studies of AI use in educational settings, and guided discussions on potential AI scenarios emerge as effective pedagogical strategies (Floridi & Cowls, 2022). These methodologies bring ethical dilemmas associated with AI into the classroom discourse, encouraging critical dialogue among future educators (Crawford & Schultz, 2014). By exposing teachers to these case studies and discussions, teacher education programs can cultivate a generation of educators well-versed in the ethical implications of AI (Mittelstadt et al., 2016).

Nevertheless, the call for a robust ethical framework in teacher education transcends the specific context of AI (Biesta, 2015). Fostering an ethical consciousness in teachers resonates deeply with the humanistic essence of education—a quintessential facet that technological advances, however profound, cannot supplant (Brey, 2012). An ethically-informed educator serves as a beacon of integrity, acting in students' best interests and upholding the teaching profession's sanctity, irrespective of the tools and technologies employed (Floridi & Taddeo, 2016).

Therefore, teacher education confronts a dual responsibility (Selwyn, 2019). It must adeptly prepare future educators for a landscape dominated by technology while simultaneously instilling an awareness of their irreplaceable human role in fostering student development (Zuboff, 2019). This delicate balance between the mechanical and the humanistic, the digital and the personal, underscores the nuanced challenge that contemporary teacher education must surmount (Pasquale, 2015). The future of education rests on our ability to navigate this complexity, marrying technological sophistication with humanistic values to usher in an era of holistic, ethical education.

CONCLUSION

In tracing the journey of this paper, a pivotal observation emerges: Generative AI's integration into education necessitates a reexamination of teacher roles and a consequent reformation of teacher education programs. The evolution of teachers from mere conveyors of knowledge to facilitators of learning, learning engineers, and ethical AI stewards signifies a monumental shift. This transformation calls for a revision of the current teacher education framework, which mirrors the changes in the classroom environment.

eISSN: 2774-2180, pISSN: 2774-2199
https://journal.unigha.ac.id/index.php/SemNas

This exploration of the interaction between Generative AI and teacher education holds significance beyond the academic domain. By highlighting the implications of technology in education, it prompts a broader conversation on the balance between technology and the human element in education. While technology such as AI offers opportunities for improved learning outcomes, it simultaneously questions educators' roles, professional development, and the nature of human interaction in classrooms.

While this research offers insights into the need for changes in teacher education, it also highlights the gaps in our understanding of how these changes can be implemented effectively. A clear call is therefore made for further research, focusing on specific strategies for reengineering teacher education programs to accommodate AI's influence. These could range from redefining course structures and developing appropriate instructional materials to effectively training teacher educators for this new role.

In conclusion, this paper reiterates the importance of embracing the digital revolution while recognising the inherent humanistic values of education. As educators and researchers, we must navigate the evolving landscape of AI integration in education with a sense of balance - harnessing the benefits of technological advancements while ensuring the human essence of teaching and learning remains intact. Through this delicate balance, we can truly shape a future of education that serves both individual learners and society.

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