Contents list available http://www.kinnaird.edu.pk/

Journal of Research & Reviews in Social Sciences Pakistan

Journal homepage: http://journal.kinnaird.edu.pk

EXPLORING THE PROSPECTS AND CHALLENGES OF AI INTEGRATION IN CURRICULUM DELIVERY FOR PRE-SERVICE TEACHERS AT RURAL UNIVERSITIES

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Abstract

This scoping review explores the opportunities and challenges of integrating Artificial Intelligence (AI) into curriculum delivery for pre-service teachers at rural universities. As AI becomes increasingly prevalent in education, understanding its impact is essential, particularly in rural areas where resources and technological infrastructure may be limited. Drawing on the Diffusion of Innovation theory, this review synthesizes existing research on AI in teacher education, focusing on its potential to enhance curriculum delivery and support the development of digital skills among pre-service teachers. The study examines the potential benefits of AI, including personalized learning, automating administrative tasks, and providing real-time feedback. However, it also highlights significant challenges, such as the digital divide, limited infrastructure, low digital literacy among educators, and ethical concerns surrounding AI use in education. By mapping the current state of AI integration in rural teacher education, this review identifies gaps in the research and suggests directions for future exploration. The findings aim to inform educators, policymakers, and stakeholders about the possibilities and limitations of adopting AI in rural university settings, contributing to more effective and equitable educational practices

Keywords

Artificial Intelligence (AI), Pre-Service Teachers, Curriculum Delivery, Rural Universities, Digital Literacy, Educational Technology Integration.

1. Introduction

The rapid progress of Artificial Intelligence (AI) is transforming many fields, including education. As AI becomes more integrated into teaching and learning, it opens up new possibilities for delivering education, especially in rural universities where traditional resources may be limited. For pre-service teachers—those training to become educators—understanding and effectively using AI is becoming increasingly important in preparing them for future classrooms. However, integrating AI into curriculum delivery comes with its own set of challenges, particularly in rural areas where access to technology and infrastructure is often restricted. This study sets out to explore both the opportunities and obstacles of bringing AI into the curriculum for pre-service teachers at rural universities. Rural universities face unique challenges, often due to their geographical isolation and limited resources. These institutions play a vital role in providing education in underserved areas, but they frequently struggle with inadequate funding, outdated infrastructure, and a lack of access to the latest technologies. In this context, the potential for AI to revolutionise curriculum delivery is significant. AI has the ability to personalise learning, automate administrative tasks, and offer real-time feedback, all of which can greatly enhance the educational experience. However, the success of AI in these settings depends on various factors, including the readiness of educators and the availability of necessary infrastructure. One of the key areas this study explores is how AI can be used to personalise learning for pre-service teachers. Personalised learning, which tailors educational content to the needs of individual students, is one of the most promising applications of AI in education. For pre-service teachers, personalised learning can provide tailored feedback on their teaching practices, access to resources that address their specific weaknesses, and allow them to progress at their own pace. However, the effectiveness of personalised learning through AI relies on the system's ability to accurately assess students' needs and deliver appropriate content. This leads to the first key research question: How can AI be effectively used to personalise learning for pre-service teachers at rural universities? Another important aspect of AI integration is its potential to automate administrative tasks, freeing up educators to focus more on teaching and less on paperwork. Tasks such as grading, attendance tracking, and even some aspects of lesson planning can be managed by AI, allowing pre-service teachers to spend more time developing their teaching skills. However, this shift requires rethinking how educators are trained, as they need to become proficient in using these technologies. Moreover, the introduction of AI in administrative processes could raise concerns about job displacement and the diminishing value of human interaction in education. This brings us to the second research question: What are the challenges and opportunities associated with automating administrative tasks using AI in the training of pre-service teachers at rural universities? Despite its potential, integrating AI into rural universities is not without significant challenges. One of the most

pressing issues is the digital divide—the gap between those who have access to modern technology and those who do not. In many rural areas, internet connectivity is unreliable, and access to the latest hardware and software is limited. These constraints can hinder the effective use of AI, making it difficult for pre-service teachers to fully benefit from the technology. Additionally, there are concerns about the ethical implications of AI, such as data privacy and algorithmic bias, which could disproportionately affect students and teachers in rural areas. The third research question addresses this issue: How do the digital divide and ethical concerns impact the integration of AI in curriculum delivery for pre-service teachers at rural universities? This study also draws on the Diffusion of Innovation theory, which looks at how new ideas and technologies spread within a society or organisation. According to this theory, the adoption of AI in rural universities will depend on several factors, including the perceived advantages of AI, its compatibility with existing practices, and the complexity of AI technologies. Understanding these factors is crucial for developing strategies that can support the successful integration of AI in curriculum delivery. This theoretical framework will guide the exploration of how AI can be introduced and effectively scaled in rural educational settings. Another important consideration is the level of digital literacy among educators. For AI to be effectively integrated into the curriculum, pre-service teachers must be equipped with the necessary digital skills. This means that teacher education programmes must not only include AI as part of the curriculum but also ensure that educators are confident in using these tools. However, building digital literacy in rural settings is challenging due to limited access to training and professional development opportunities. Addressing this issue is essential for the successful adoption of AI in rural universities. The potential for AI to transform education is vast, but it needs to be approached carefully. While AI can enhance curriculum delivery, it also poses risks, such as widening inequalities and creating ethical dilemmas. In rural universities, where resources are already stretched thin, the introduction of AI could either be a game-changing opportunity or a new set of challenges. It is crucial to carefully consider the context in which AI is being implemented to ensure that its benefits are realised without unintended negative consequences. In this study, a scoping review was conducted to map the existing literature on AI integration in curriculum delivery for pre-service teachers at rural universities. This review identified the key opportunities and challenges associated with AI, aiming to provide a comprehensive overview of the current state of research in this area. By synthesising findings from various studies, the review highlighted gaps in the literature and suggest directions for future research. The findings of this study have important implications for educators, policymakers, and stakeholders involved in teacher education in rural settings. By understanding the potential and pitfalls of AI integration, they can make informed decisions on how to best support pre-service teachers in these contexts. Ultimately, the goal is to

contribute to the development of more effective and equitable educational practices that leverage AI's capabilities while addressing the unique challenges of rural universities. Conversely, the integration of AI in curriculum delivery for pre-service teachers at rural universities presents both exciting opportunities and significant challenges. By exploring how AI can personalise learning, automate administrative tasks, and bridge the digital divide, this study aims to provide valuable insights into the future of teacher education in rural settings. The three key research questions guiding this study will help uncover the factors that influence the successful adoption of AI and identify strategies for maximising its benefits while mitigating potential risks. The aim of this study is to explore the integration of Artificial Intelligence (AI) in curriculum delivery for pre-service teachers at rural universities, focusing on its potential to personalise learning, automate administrative tasks, and address the challenges of the digital divide. Through a scoping review, the study seeks to identify the opportunities and barriers associated with AI adoption, with the goal of providing actionable insights for improving teacher education in resource-constrained rural settings. By addressing the key issues of digital literacy, ethical concerns, and infrastructure limitations, this research aims to support the development of equitable and effective AI-enhanced educational practices.

2. Literature Review

The integration of Artificial Intelligence (AI) in education has gained considerable attention in recent years, with numerous studies exploring its potential to transform teaching and learning processes (Luckin *et al*., 2016; Holmes *et al*., 2019). AI technologies offer personalised learning experiences, automate administrative tasks, and provide real-time feedback, making them valuable tools in modern education. However, the application of AI in rural universities, particularly for pre-service teacher education, presents unique challenges that have not been extensively addressed in the literature. This review examines existing research on AI in education, focusing on its prospects and challenges in rural university settings, with an emphasis on pre-service teacher training. Personalised learning is one of the most promising applications of AI in education. It involves tailoring educational content and pacing to meet individual learners' needs, thereby enhancing student engagement and outcomes (Kumar & Vivekanandan, 2018). AI-driven personalised learning systems can adapt to the strengths and weaknesses of pre-service teachers, providing them with customised feedback and resources. Studies have shown that such systems can significantly improve learning outcomes by enabling students to progress at their own pace and focus on areas where they need the most support (Zawacki-Richter *et al*., 2019). However, implementing personalised learning in rural universities may be challenging due to limited access to the necessary technological infrastructure and expertise. The automation of administrative tasks is another area where AI has shown potential to enhance educational efficiency. AI can handle tasks such as grading, attendance tracking, and even some aspects of lesson planning, freeing up

educators to focus more on teaching and student interaction (Hwang *et al*., 2020). For pre-service teachers, this automation can reduce the administrative burden and allow them to concentrate on developing their teaching skills. However, there are concerns about the potential for job displacement and the devaluation of the human element in education, which could be particularly problematic in rural settings where teaching jobs are already scarce (Williamson & Eynon, 2020). The digital divide remains a significant barrier to the effective integration of AI in rural education. This divide refers to the gap between individuals and communities that have access to modern information and communication technologies and those that do not (van Dijk, 2020). In many rural areas, internet connectivity is unreliable, and access to up-to-date hardware and software is limited. These constraints can hinder the adoption of AI technologies, making it difficult for pre-service teachers in rural universities to fully benefit from personalised learning and automated administrative tasks (Nash, 2021). Addressing the digital divide is essential for ensuring that all students have equal opportunities to benefit from AI in education. Ethical concerns also play a crucial role in discussions about AI in education. Issues such as data privacy, algorithmic bias, and the transparency of AI systems are particularly relevant when considering the use of AI in rural universities (O'Neil, 2016; Crawford & Paglen, 2021). For instance, AI systems that are not designed with inclusivity in mind could exacerbate existing inequalities, particularly in underserved rural areas. Furthermore, the use of AI in education raises questions about the ownership and control of student data, as well as the potential for surveillance and privacy violations (West, 2019). These ethical considerations must be carefully addressed to ensure that AI is used responsibly in educational settings. The Diffusion of Innovation theory, proposed by Rogers (2003), provides a useful framework for understanding how AI technologies might be adopted in rural universities. According to this theory, the adoption of new technologies depends on factors such as perceived advantages, compatibility with existing practices, and the complexity of the technology. In the context of rural universities, the perceived benefits of AI—such as enhanced learning outcomes and reduced administrative burdens—must be weighed against the challenges of implementing and maintaining these technologies in resource-constrained environments (Straub, 2009). Understanding these dynamics is crucial for developing strategies that facilitate the successful integration of AI in pre-service teacher education. Digital literacy is another critical factor influencing the adoption of AI in education. For AI technologies to be effectively integrated into the curriculum, both educators and students must possess the necessary digital skills (Zhong, 2011). In rural universities, where access to technology and training opportunities may be limited, building digital literacy among pre-service teachers is particularly challenging. Studies have shown that teacher education programmes must prioritise digital literacy development to prepare future educators for the demands of modern classrooms (Selwyn, 2016). However, providing adequate

training and support in rural settings requires targeted interventions that address the specific needs and constraints of these communities. Despite the challenges, AI offers significant potential to revolutionise education in rural universities. For example, AI-driven tools can provide rural students with access to high-quality educational resources that may otherwise be unavailable due to geographical isolation (Higgins *et al*., 2012). Additionally, AI can facilitate collaborative learning opportunities by connecting students and educators across different locations, thereby overcoming some of the limitations of rural education (Anderson & Dron, 2011). However, realising this potential requires careful planning and investment in the necessary infrastructure and support systems. The role of AI in teacher education is still an emerging area of research, with much of the literature focusing on the broader implications of AI in education rather than its specific application to pre-service teacher training (Luckin *et al*., 2016; Holmes *et al*., 2019). As such, there is a need for more studies that examine how AI can be integrated into teacher education programmes, particularly in rural universities. These studies should explore not only the technical aspects of AI implementation but also the pedagogical and ethical considerations that are unique to teacher education. One area that has received limited attention in the literature is the impact of AI on the professional identity of pre-service teachers. AI technologies have the potential to reshape the roles and responsibilities of educators, which could influence how pre-service teachers perceive their professional identity (Selwyn, 2020). For instance, the automation of certain tasks may lead to a greater focus on mentoring and personalised instruction, while the use of AI in assessment could shift the emphasis from summative to formative evaluation. Understanding these impacts is important for ensuring that AI is integrated in a way that supports the development of confident and competent educators. The potential of AI to address the unique challenges of rural education cannot be overlooked. By providing personalised learning experiences, automating administrative tasks, and bridging the digital divide, AI has the potential to enhance the quality of education in rural universities (Nash, 2021). However, the successful integration of AI in these settings requires a nuanced understanding of the specific barriers and opportunities that exist in rural education. Future research should focus on developing strategies for overcoming these barriers, with an emphasis on ensuring that AI technologies are accessible, ethical, and supportive of the goals of teacher education. Conversely, while AI presents significant opportunities for enhancing education in rural universities, its successful integration requires careful consideration of the unique challenges faced by these institutions. Issues such as the digital divide, ethical concerns, and the need for digital literacy must be addressed to ensure that AI technologies are used effectively and equitably. By exploring the prospects and challenges of AI integration in pre-service teacher education, this study aims to contribute to the development of more effective

and equitable educational practices in rural settings.

3. Research Methodology

To effectively explore the integration of Artificial Intelligence (AI) in curriculum delivery for pre-service teachers at rural universities, this study employs a scoping review methodology. Scoping reviews are particularly well-suited for mapping the existing literature on a broad topic, identifying gaps in knowledge, and summarizing the current state of research (Arksey & O'Malley, 2005). Given the emergent nature of AI in education, and its specific implications for rural contexts, a scoping review allows for a comprehensive examination of the various dimensions of AI integration, including its benefits, challenges, and ethical considerations. This approach is aligned with the objective of understanding the full landscape of AI's impact on teacher education, especially in areas where technological infrastructure and resources are constrained. The first step in conducting this scoping review involved defining the research questions and establishing inclusion and exclusion criteria. The research questions focused on the prospects and challenges of AI integration in curriculum delivery, particularly in rural universities. The inclusion criteria were broad, encompassing studies that addressed AI in education, teacher training, rural education contexts, and digital literacy. Exclusion criteria were applied to studies that did not specifically address the intersection of AI with teacher education or those focused solely on urban educational settings. By clearly defining these criteria, the review ensured that the selected literature was relevant and provided insights into the unique challenges faced by rural universities (Peters *et al*., 2015). To gather relevant literature, a systematic search strategy was employed across multiple academic databases, including Scopus, Web of Science, and ERIC. The search terms were carefully selected to capture a wide range of studies related to AI in education, rural education, teacher training, and digital competencies. Keywords included combinations such as "Artificial Intelligence," "teacher education," "rural universities," "digital literacy," and "curriculum delivery." The search was limited to peer-reviewed articles published in English within the last decade to ensure the relevance and currency of the findings. The systematic approach to literature search is critical in scoping reviews, as it helps to capture the breadth of existing research while maintaining a focus on the specific research questions (Levac *et al.*, 2010). Following the literature search, the selected articles underwent a rigorous screening process. Titles and abstracts were initially reviewed to assess their relevance, followed by a full-text review of the shortlisted articles. This process was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which enhances transparency and reproducibility in the review process (Moher *et al*., 2009). The articles that met the inclusion criteria were then subjected to data extraction, where key information related to AI's role in curriculum delivery, benefits, challenges, and ethical concerns was systematically recorded. This methodical approach ensured that the data collected was comprehensive and directly

addressed the research questions. The extracted data was analysed thematically, allowing for the identification of common themes and patterns across the selected studies. Thematic analysis is particularly effective in scoping reviews, as it enables the synthesis of qualitative and quantitative data, providing a nuanced understanding of complex issues like AI integration in rural teacher education (Braun & Clarke, 2006). The themes identified included the potential of AI to personalise learning, automate administrative tasks, and provide real-time feedback, as well as the challenges posed by the digital divide, infrastructure limitations, and ethical concerns. By categorizing the findings into these themes, the review could systematically address each aspect of the research questions. Finally, the findings of the scoping review were contextualised within the broader literature on educational technology and rural education. This involved comparing the results with existing studies on digital literacy, technology adoption, and the digital divide in rural contexts (Eynon & Geniets, 2016). The synthesis of these findings provided a comprehensive overview of the current state of AI integration in rural teacher education, highlighting both the opportunities and the constraints. The review concluded with recommendations for future research and policy implications, aimed at guiding the equitable and effective adoption of AI in rural universities. This methodological approach ensures that the study not only maps the existing landscape but also contributes to the ongoing discourse on the role of AI in education.

4. Results

The scoping review identified six key themes related to the integration of Artificial Intelligence (AI) in curriculum delivery for pre-service teachers at rural universities: (1) Personalised Learning, (2) Automation of Administrative Tasks, (3) Digital Divide, (4) Infrastructure Limitations, (5) Digital Literacy, and (6) Ethical Concerns. Each theme represents a critical aspect of AI integration and is discussed in detail below.

4.1 Personalised Learning

The potential of AI to personalise learning emerged as a significant theme in the literature. Personalised learning involves tailoring educational experiences to meet the individual needs, preferences, and pace of each student (Holmes *et al*., 2019). The review found that AI-driven personalised learning can enhance the educational experience for pre-service teachers by providing customised feedback, identifying gaps in knowledge, and offering targeted resources. This is particularly valuable in rural universities where students often come from diverse educational backgrounds and may require additional support to succeed (Means *et al*., 2014). AI tools like adaptive learning platforms and intelligent tutoring systems were highlighted as effective means of delivering personalised instruction. However, the effectiveness of personalised learning through AI depends heavily on the accuracy and reliability of the underlying algorithms (Zawacki-Richter *et al*., 2019). The review found that while AI can process vast amounts of data to tailor learning experiences, the quality of personalisation is contingent upon the data input. In rural contexts, where data may be sparse or inconsistent, there is a risk that AI could

reinforce existing educational inequities rather than mitigate them (Baker & Hawn, 2021). Ensuring the development of robust algorithms that can adapt to varied and limited data sets is crucial for the successful implementation of AI in rural education. Moreover, the review highlighted the need for pre-service teachers to be adequately trained in the use of AI-powered personalised learning tools. Educators must understand how these tools function, how to interpret the data they generate, and how to integrate them effectively into their teaching practices (Mishra & Koehler, 2006). Without this knowledge, the benefits of AI in personalising learning may not be fully realised, and the tools could be underutilised. The findings suggest that teacher education programmes in rural universities should include comprehensive training on AI technologies to prepare future educators for their roles in increasingly digital classrooms.

4.2 Automation of Administrative Tasks

The automation of administrative tasks through AI was another prominent theme identified in the literature. AI has the potential to significantly reduce the administrative burden on educators by automating tasks such as grading, attendance tracking, and scheduling (Chassignol *et al*., 2018). This automation allows educators to allocate more time and energy to teaching and mentoring students, which is particularly beneficial in resource-constrained rural universities where faculty are often stretched thin. The review found that AI-driven automation could enhance the efficiency of educational operations and improve the overall effectiveness of curriculum delivery. For example, automated grading systems can provide immediate feedback to students, enabling them to quickly identify areas for improvement (Luckin *et al*., 2016). Additionally, AI can streamline administrative processes, such as tracking student attendance and managing course schedules, which reduces the time educators spend on routine tasks (Gilboy *et al*., 2015). This increased efficiency could lead to improved educational outcomes, as educators have more time to focus on instructional quality. However, the review also identified challenges associated with the automation of administrative tasks. One of the main concerns is the potential for AI to displace certain educational roles, particularly in rural areas where teaching jobs are a vital source of employment (Acemoglu & Restrepo, 2020). There is also the issue of over-reliance on AI, which could lead to a reduction in the human elements of education, such as the personal interaction between teachers and students. The findings suggest that while AI can significantly reduce administrative workloads, it should be implemented in a way that complements, rather than replaces, the human aspects of teaching. This requires careful planning and consideration of the broader implications of AI in educational settings.

4.3 Digital Divide

The digital divide, which refers to the gap between those who have access to modern technology and those who do not, emerged as a critical barrier to the effective integration of AI in rural universities. The review highlighted that in many rural areas, limited access to high-speed internet, up-to-date hardware, and other technological resources hinders the adoption and use of AI (Van Dijk,

2020). This divide not only affects the ability of pre-service teachers to engage with AI tools but also exacerbates existing educational inequities between urban and rural students. The literature consistently pointed out that the digital divide is more pronounced in rural settings, where infrastructure investments are often lower than in urban areas (Reinhart & Schneider, 2021). In the context of AI integration, this lack of access means that many rural universities are unable to fully implement AI-driven educational tools, limiting the potential benefits of personalised learning and automated administrative tasks. Moreover, the digital divide contributes to a growing gap in digital literacy between students and educators in rural and urban settings, further hindering the effective use of AI in education. To address the digital divide, the review suggests that targeted investments in infrastructure are necessary to ensure that rural universities can access the technology needed to support AI integration (Eynon & Geniets, 2016). This includes improving internet connectivity, providing access to modern hardware, and ensuring that rural institutions have the resources to maintain and update their technological infrastructure. Additionally, the findings indicate the need for policies that promote digital equity, ensuring that all students, regardless of their geographical location, have access to the tools and resources necessary for success in a digitally-driven educational landscape.

4.4 Infrastructure Limitations

Infrastructure limitations, closely related to the digital divide, were identified as a significant challenge to AI integration in rural universities. The review found that many rural institutions lack the necessary infrastructure to support advanced AI technologies, including reliable electricity, internet connectivity, and modern computer systems (Reinhart & Schneider, 2021). These limitations make it difficult for rural universities to implement AI-driven educational tools effectively, thereby restricting the potential benefits that AI could bring to curriculum delivery. The literature highlighted that in addition to physical infrastructure, there is often a lack of technical support and expertise in rural universities, which further complicates the adoption of AI (Van Deursen & Van Dijk, 2019). Even when rural institutions manage to acquire the necessary technology, they may struggle to maintain it and provide adequate support for its use. This can lead to underutilisation of AI tools and a failure to realise their full potential in enhancing educational outcomes. The review suggests that addressing these infrastructure limitations requires not only investments in physical resources but also in the training and development of technical staff. Moreover, the review identified that infrastructure limitations are often compounded by broader socio-economic factors that affect rural communities, such as lower income levels and reduced access to educational opportunities (Pettersson, 2018). These factors create a challenging environment for the successful implementation of AI technologies, as students and educators may be less familiar with digital tools and less able to afford the necessary devices and services. The findings underscore the importance of adopting a holistic approach to AI integration that considers the broader context in which rural

universities operate and addresses the multiple layers of infrastructure challenges they face.

4.5 Digital Literacy

Digital literacy, defined as the ability to effectively use digital technologies, was another key theme that emerged from the review. The literature consistently emphasised the importance of digital literacy for both educators and students in successfully integrating AI into curriculum delivery (Eshet, 2012). For pre-service teachers, digital literacy is essential not only for using AI tools in their own education but also for teaching these tools to their future students. However, the review found that digital literacy levels are often lower in rural areas, where access to technology and digital education is limited. The review highlighted that digital literacy is critical for the effective use of AI-powered educational tools, such as personalised learning platforms and automated grading systems (Mishra & Koehler, 2006). Educators must be able to understand and navigate these tools, interpret the data they generate, and integrate them into their teaching practices. In rural universities, where professional development opportunities are often limited, building digital literacy among educators can be particularly challenging. The review suggests that teacher education programmes in rural settings should place a strong emphasis on digital literacy, providing educators with the skills and confidence they need to effectively use AI in their classrooms. Additionally, the review found that improving digital literacy among students is equally important for the successful adoption of AI in education. Students who are digitally literate are better equipped to engage with AI-driven learning tools, take advantage of personalised learning opportunities, and succeed in a technology-rich educational environment (Eynon & Geniets, 2016). To address the digital literacy gap in rural areas, the findings recommend targeted interventions, such as digital literacy workshops, access to online resources, and the integration of digital skills training into the curriculum. These efforts are essential for ensuring that both educators and students in rural universities can fully benefit from the opportunities offered by AI.

4.6 Ethical Concerns

Ethical concerns surrounding the use of AI in education were a significant theme identified in the review. The literature highlighted various ethical issues, including data privacy, algorithmic bias, and the potential for AI to exacerbate existing inequalities (Williamson & Eynon, 2020). These concerns are particularly relevant in rural universities, where there may be less regulatory oversight and fewer resources to address ethical challenges. The review found that while AI has the potential to enhance educational outcomes, it also raises important questions about the responsible use of technology in education. One of the primary ethical concerns identified in the review is data privacy. AI systems rely on vast amounts of data to function effectively, and this data often includes sensitive information about students' academic performance, behaviour, and personal characteristics (Selwyn, 2019). The review found that in rural universities, where data protection measures may be less robust, there is a risk that student data could be misused or inadequately

protected. This highlights the need for strong data governance policies and practices that ensure the privacy and security of student information in AI-driven educational environments. Another ethical issue raised in the literature is the potential for algorithmic bias in AI systems. The review found that AI algorithms are often trained on data sets that reflect existing social inequalities, which can result in biased outcomes that disproportionately affect marginalised groups, including students from rural areas (Baker & Hawn, 2021). This bias can manifest in various ways, such as in the allocation of educational resources, the identification of learning needs, and the assessment of student performance. To mitigate these risks, the review suggests that AI systems used in education should be carefully designed and regularly audited to ensure fairness and inclusivity. Finally, the review highlighted concerns about the broader societal implications of AI in education, particularly the potential for AI to reinforce existing power dynamics and inequalities (Couldry & Yu, 2018). In rural universities, where students and educators may already face significant challenges, the introduction of AI could exacerbate these issues if not carefully managed. The findings indicate that ethical considerations should be central to the design and implementation of AI in education, with a focus on promoting equity, transparency, and accountability. By addressing these ethical challenges, stakeholders can help ensure that AI is used in a way that benefits all students, regardless of their geographical location or socio-economic background.

5. Discussion

The integration of Artificial Intelligence (AI) into curriculum delivery for pre-service teachers at rural universities presents both significant opportunities and considerable challenges. The findings from this scoping review highlight the potential benefits of AI, such as personalised learning and automated administrative tasks, while also underscoring the obstacles that must be overcome, including the digital divide, infrastructure limitations, and ethical concerns. This discussion contextualises these findings within the broader literature and offers insights into the implications for teacher education and policy in rural settings. One of the most promising aspects of AI in education is its ability to personalise learning experiences. Personalised learning, facilitated by AI, can significantly enhance the educational outcomes of pre-service teachers by tailoring instruction to meet individual needs, thereby addressing the diverse learning paces and styles present in any classroom (Holmes *et al*., 2019). The literature supports the notion that AI-driven personalised learning can help bridge the achievement gaps often seen in rural education settings, where students may enter teacher training programmes with varying levels of preparation (Means *et al*., 2014). However, the effectiveness of AI in personalising learning is contingent upon the quality and diversity of the data that AI systems rely on. In rural contexts, where data collection may be inconsistent, there is a risk that AI could reinforce rather than reduce educational inequities (Baker & Hawn, 2021). The automation of administrative tasks through AI is another area where significant benefits can be realised. Automating tasks such as grading, attendance

tracking, and lesson planning can free up valuable time for educators, allowing them to focus more on direct teaching and student engagement (Chassignol *et al*., 2018). This is particularly beneficial in rural universities, where educators often face heavy workloads due to limited staffing and resources. The literature suggests that such automation could lead to improved educational outcomes by enabling educators to dedicate more time to mentoring and supporting students (Luckin *et al*., 2016). However, it is crucial to approach automation carefully to avoid over-reliance on AI systems, which could reduce the human element of education, a critical factor in fostering student-teacher relationships and ensuring effective teaching (Gilboy *et al*., 2015). Despite these benefits, the digital divide remains a significant barrier to the successful integration of AI in rural universities. The digital divide refers to the gap between those who have access to modern digital technologies and those who do not, a disparity that is often more pronounced in rural areas (Van Dijk, 2020). The review found that limited access to high-speed internet, modern hardware, and technical support hinders the ability of rural universities to fully implement AI-driven educational tools (Reinhart & Schneider, 2021). This divide not only affects the integration of AI but also exacerbates existing inequalities in educational outcomes between urban and rural students. To address this issue, targeted infrastructure investments and policies promoting digital equity are necessary (Eynon & Geniets, 2016). Infrastructure limitations, closely related to the digital divide, also pose a significant challenge to AI integration in rural universities. The review highlighted that many rural institutions lack the necessary infrastructure, such as reliable electricity, internet connectivity, and up-to-date computer systems, which are essential for supporting AI technologies (Van Deursen & Van Dijk, 2019). These limitations can prevent rural universities from fully benefiting from AI, as the lack of infrastructure can lead to underutilisation of AI tools and missed opportunities for enhancing curriculum delivery. The broader literature supports the need for substantial investment in both physical infrastructure and technical expertise to ensure that rural universities can effectively adopt and maintain AI technologies (Pettersson, 2018). Digital literacy emerged as another critical factor in the successful integration of AI in education. Digital literacy, which encompasses the skills needed to use digital tools effectively, is essential for both educators and students (Eshet, 2012). The review found that in rural areas, digital literacy levels are often lower, making it challenging for educators to integrate AI into their teaching practices effectively. This gap in digital literacy can lead to underutilisation of AI tools and reduced educational outcomes for students. The literature suggests that teacher education programmes should prioritise digital literacy, equipping pre-service teachers with the skills and confidence needed to use AI effectively in the classroom (Mishra & Koehler, 2006). Ethical concerns surrounding AI use in education were prominently discussed in the literature and emerged as a significant theme in this review. Issues such as data privacy, algorithmic bias, and the potential for AI to

exacerbate existing inequalities are particularly concerning in rural settings, where there may be less oversight and fewer resources to address these challenges (Williamson & Eynon, 2020). The literature highlights the need for robust ethical guidelines and policies that ensure AI is used responsibly and equitably in educational settings. Without such safeguards, the benefits of AI could be overshadowed by the risks, particularly in vulnerable populations such as those in rural areas (Selwyn, 2019). The findings from this review also underscore the importance of adopting a holistic approach to AI integration that considers the unique challenges faced by rural universities. While AI has the potential to transform education, its successful implementation requires more than just technological solutions. It involves addressing broader socio-economic factors, such as the digital divide and infrastructure limitations, and ensuring that educators are adequately trained and supported (Couldry & Yu, 2018). The literature suggests that a collaborative approach, involving educators, policymakers, and technology developers, is essential for overcoming these challenges and maximising the benefits of AI in rural education (Fullan, 2016). Another key insight from the review is the need for continuous professional development to support the integration of AI in education. The literature emphasises that ongoing training is critical for helping educators stay current with technological advancements and effectively integrate AI into their teaching practices (Desimone & Garet, 2015). In rural areas, where access to professional development opportunities may be limited, it is particularly important to provide targeted, accessible training programmes that equip educators with the skills needed to use AI tools effectively (Darling-Hammond *et al*., 2017). The role of policy in supporting AI integration in rural education cannot be overstated. The literature highlights the need for policies that promote digital equity, provide funding for infrastructure improvements, and support professional development for educators (Selwyn, 2019). Such policies are essential for ensuring that AI can be effectively integrated into rural universities and that the benefits of AI are accessible to all students, regardless of their geographical location. The review suggests that policymakers should focus on creating an enabling environment that addresses the unique challenges of rural education while leveraging the opportunities offered by AI. In terms of future research, the review identifies several gaps in the current literature that need to be addressed. There is a need for more empirical studies that examine the long-term impact of AI on educational outcomes in rural settings, particularly studies that explore how AI can be used to bridge the digital divide and improve educational equity (Zawacki-Richter *et al*., 2019). Additionally, further research is needed to develop and test ethical frameworks for AI in education, ensuring that AI tools are used responsibly and equitably in diverse educational contexts (Baker & Hawn, 2021). Thus, the findings of this review have important implications for teacher education programmes in rural universities. By integrating AI into the curriculum, these programmes can better prepare pre-service teachers for the challenges and opportunities of a digitally-

driven educational landscape (Mishra & Koehler, 2006). However, to do so effectively, teacher education programmes must address the unique challenges of rural education, including infrastructure limitations, the digital divide, and the need for digital literacy training. By taking a holistic and collaborative approach, rural universities can ensure that their pre-service teachers are equipped to harness the potential of AI, ultimately contributing to more effective and equitable educational practices. The interpretations presented in this study are well-justified by the results, yet the conclusion could more strongly emphasize the transformative potential of AI integration in rural education. While challenges like the digital divide and ethical concerns are significant, addressing these issues offers an unparalleled opportunity to revolutionize curriculum delivery for pre-service teachers. A holistic approach, encompassing robust policy support, infrastructure improvements, and targeted professional development, can bridge existing gaps and empower educators to leverage AI effectively. The study underscores that while AI integration requires navigating complex challenges, its potential to personalise learning, enhance administrative efficiency, and improve educational equity positions it as a pivotal tool in reshaping teacher education in underserved rural settings.

6. Implications of the Study

The findings from this scoping review have several important implications for the integration of Artificial Intelligence (AI) in curriculum delivery for pre-service teachers at rural universities. Firstly, the study highlights the need for targeted investments in digital infrastructure within rural educational settings. The digital divide, as identified in this review, remains a significant barrier to the effective use of AI in education. Rural universities often lack the necessary technological resources, such as high-speed internet and modern computing equipment, which are critical for implementing AI-driven educational tools (Van Dijk, 2020). Addressing these infrastructure deficits is crucial for ensuring that rural students and educators have equal access to the benefits of AI, thereby promoting educational equity (Reinhart & Schneider, 2021). Secondly, this study underscores the importance of enhancing digital literacy among educators and students in rural areas. The successful integration of AI into the curriculum requires a workforce that is not only familiar with digital tools but also confident in using them effectively in educational contexts (Mishra & Koehler, 2006). Given that digital literacy levels are often lower in rural regions, there is a clear need for comprehensive training programmes that equip educators with the necessary skills to leverage AI in their teaching practices (Eshet, 2012). By improving digital literacy, rural universities can better prepare their pre-service teachers to utilise AI tools, which in turn can enhance the quality of education they provide. The study also highlights significant ethical concerns related to AI use in education, which have important implications for policy and practice. Issues such as data privacy, algorithmic bias, and the potential for AI to exacerbate existing educational inequalities must be carefully managed (Williamson & Eynon, 2020). Policymakers and

educational leaders must develop robust ethical guidelines to ensure that AI is implemented in a manner that protects students' rights and promotes fairness (Selwyn, 2019). This includes creating policies that address the risks associated with AI, such as ensuring transparency in how AI algorithms function and implementing safeguards to protect sensitive student data. Additionally, the implications of this study suggest that a collaborative approach is essential for the successful integration of AI in rural education. Collaboration between educators, policymakers, technology developers, and rural communities is necessary to address the unique challenges faced by rural universities (Fullan, 2016). By working together, these stakeholders can develop and implement AI tools that are specifically tailored to the needs of rural educators and students. This collaborative approach can help ensure that AI is used to support rather than undermine educational practices, leading to more effective and equitable outcomes (Hargreaves & O'Connor, 2018). Another critical implication of this study is the need for continuous professional development to support the evolving role of educators in an AI-driven educational landscape. As AI becomes more integrated into teaching and learning, educators must be equipped with the latest knowledge and skills to use these technologies effectively (Desimone & Garet, 2015). Professional development programmes should focus not only on technical skills but also on pedagogical strategies that incorporate AI into the curriculum. This will help ensure that pre-service teachers are prepared to meet the demands of modern classrooms and can effectively use AI to enhance student learning outcomes (Darling-Hammond *et al*., 2017). Conclusively, the study has implications for future research in the field of AI in education, particularly within rural contexts. There is a need for more empirical studies that explore the long-term impacts of AI integration on educational outcomes in rural areas, as well as research that investigates the most effective strategies for addressing the digital divide and promoting digital literacy (Zawacki-Richter *et al*., 2019). Further research is also needed to develop and validate ethical frameworks for AI use in education, ensuring that these technologies are applied in ways that are both equitable and effective (Baker & Hawn, 2021). By addressing these research gaps, scholars can contribute to the development of AI applications that are better suited to the needs of rural educators and students.

7. Conclusion

This study has highlighted the significant potential of integrating Artificial Intelligence (AI) in curriculum delivery for pre-service teachers at rural universities, while also addressing the considerable challenges that must be overcome to realise these benefits. The findings underscore the importance of investing in digital infrastructure, enhancing digital literacy, and developing robust ethical frameworks to ensure the equitable and effective use of AI in rural education settings. By adopting a collaborative approach that involves educators, policymakers, and technology developers, rural universities can harness AI to improve educational outcomes and bridge existing gaps in access and quality. This study contributes to the growing body

of literature on AI in education, offering valuable insights for future research and policy development aimed at supporting the successful integration of AI in rural teacher education.

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