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Evaluating the Impact of Artificial Intelligence on Reducing Administrative Burden and Enhancing Instructional Efficiency in Middle Schools

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ABSTRACT

This study examines the effectiveness of artificial intelligence (AI) tools in reducing administrative burdens and enhancing instructional efficiency in middle schools. Using a systematic literature review with bibliometric analysis (SLRBA), the study analysed data from databases such as Google Scholar, PubMed, Scopus, and JSTOR. It highlights AI's ability to automate tasks, provide real-time feedback, and generate reports, allowing teachers to focus on instructional activities and improving teaching quality and student outcomes. Ethical considerations were also addressed, including privacy, confidentiality, and copyright compliance. The findings reveal that AI tools significantly save time for teachers, enhancing instructional efficiency. While teachers view AI as beneficial, concerns about its accuracy, potential impact on teacher roles, and ethical issues like data privacy remain significant. Human oversight and comprehensive teacher training are deemed essential for successful AI integration. In conclusion, while AI tools offer transformative potential, addressing ethical concerns and optimizing teacher preparedness is critical for maximizing their benefits. Future research should investigate AI's long-term impact, broaden demographic inclusion, and explore strategies for effective implementation to leverage its capabilities fully in middle school education.

KEYWORDS

Artificial intelligence (AI); administrative burden; instructional efficiency; middle schools; teacher perceptions.

Introduction

The integration of artificial intelligence (AI) in educational evaluation has advanced significantly, enhancing both teaching and learning processes (Kamalov et al., 2023). AI automates grading, offers personalized feedback, and supports learning analytics and artificial intelligence (LAAI) systems, which assess instructional quality and track student progress (Martínez-Comesaña et al., 2023; García-Martínez et al., 2023). It aids teachers and policymakers in evaluating classroom solutions, providing real-time analysis, and generating data-driven reports to improve educational practices (Boston, 2012; Tapalova & Zhiyenbayeva, 2022). Predominantly applied in online education platforms, AI enhances student engagement and administrative efficiency, as demonstrated by Majorana et al.'s (2022) chatbot, which reduced inquiry wait times and improved response efficiency. Research also highlights AI's potential in evaluating primary and secondary student performance, emphasizing its benefits and challenges (Ayala-Pazmiño, 2023; Martínez-Comesaña et al., 2023; Okagbue et al., 2023; Caspari-Sadeghi, 2022). AI thus represents a transformative tool in modern education. Overcoming technological obstacles, making sure educators are prepared, and encouraging cooperation between humans and machines are all necessary for successful integration.

Based on the above background, the goal of this study is to explore the effectiveness of AI tools in reducing the time teachers spend on administrative tasks and examine how this time reallocation affects instructional practices and student outcomes in middle schools.

The objective of this review is to measure the amount of time saved on administrative tasks by AI tools while evaluating how they improve educational activities. In addition to gathering instructor views about instructional quality and student engagement, it assesses the precision and dependability of these tools in educational settings. The assessment also looks at how AI tools affect student results, offering a thorough examination of their total educational influence.

To ensure objectivity and facilitate data curation and analysis, a Systematic Literature Review (SLR) was conducted to address key research questions. The review aimed to determine the extent to which teachers report a reduction in administrative task time following the implementation of AI tools in their workflow. It also explored the perceived impact of this reduction on teachers' ability to focus more on instructional activities and student interaction. Additionally, the study examined whether teachers feel that AI tools effectively manage the accuracy and reliability of administrative tasks compared to traditional manual methods.

Theoretical Framework

This study examines how well AI technologies may reduce administrative hassles and improve instructional efficiency by integrating important theories. According to the Task-Technology Fit (TTF) Theory, technology is only useful when it is in line with users' tasks and makes completing them easier (Vendramin et al., 2021). The Technology Acceptance Model (TAM) (Lin & Yu, 2023; Zhou et al., 2022), the Theory of Reasoned Action (TRA) (Anisman & Kusnecov, 2022), and the Theory of Planned Behavior (TPB) (Bosnjak et al., 2020) are theories that look at attitudes, norms, and behavioral control that influence technology acceptance (Ajzen, 2011; Venkatesh et al., 2003). In contrast, TTF investigates post-adoption utilization. In order to successfully integrate AI tools,

teachers must balance their technological, pedagogical, and content knowledge, according to the Technological Pedagogical Content Knowledge (TPACK) framework (Koehler & Mishra, 2009). AI integration levels, ranging from simple substitution to instructional transformation, are examined using the SAMR Model (Hamilton et al., 2016). Furthermore, the Time-on-Task theory (Godwin et al., 2021) investigates how AI affects student engagement and administrative effectiveness. The study also looks into Teacher Cognition (Chen & Abdullah, 2022), which deals with instructors' opinions and choices on the precision and dependability of AI tools. When combined, these frameworks offer a thorough grasp of how AI is changing teaching methods and improving student results.

Research hypotheses

The study is framed by five hypotheses exploring AI's role in education. It posits that AI tools reduce teachers' administrative task time (Hypothesis 1), enabling enhanced instructional focus (Hypothesis 2), which positively impacts student performance and engagement (Hypothesis 3). Teachers view AI as beneficial for workload reduction but express concerns about accuracy and job role impacts (Hypothesis 4). Lastly, AI tools are considered accurate and reliable for administrative tasks, though occasional errors require human oversight (Hypothesis 5). Together, these hypotheses underpin the study's investigation into how AI transforms educational workflows and improves outcomes.

Research Methodology

Comprehensive Framework for the Systematic literature review

The study's conceptual framework was developed through background reading, literature review, and concept mapping to align AI-related concepts with objectives. This process synthesized research questions and identified essential keywords for a systematic literature review with bibliometric analysis (SLRBA), ensuring a thorough exploration of administrative task reduction, instructional efficiency, and student outcomes (Lester, 2005; Kitchenham et al., 2010). Following PRISMA criteria (Page et al., 2021), data was collected from databases like Google Scholar, PubMed, Scopus, Web of Science, JSTOR, and ProQuest, using a comprehensive search strategy with Boolean terms. The search used relevant keywords combined using the Boolean term "OR" (e.g., AI tools/administrative tasks reduction/instructional efficiency). Articles published between 2004 and 2023 were analyzed, employing an eight-step methodology (Rosário et al., 2021) to ensure accuracy and relevance.

The inclusion criteria required original, English-language journal articles or conference proceedings, excluding theses and dissertations. Due to limited AI research in middle schools, web pages and books were included. Selected documents had to address AI's impact on reducing administrative burden and enhancing instructional efficiency, with full-text availability or DOI access.

Article selection process

Initially, 244 records were identified from various databases and screened for title and keyword relevance. After removing 100 duplicates and 50 ineligible records using automation tools, 94 articles were retained. These articles were further screened by reading abstracts for relevant information. Final screening based on predefined inclusion criteria excluded articles not meeting all criteria. This stepwise selection process resulted in 22 articles being chosen for qualitative synthesis, as shown in Figure 1.

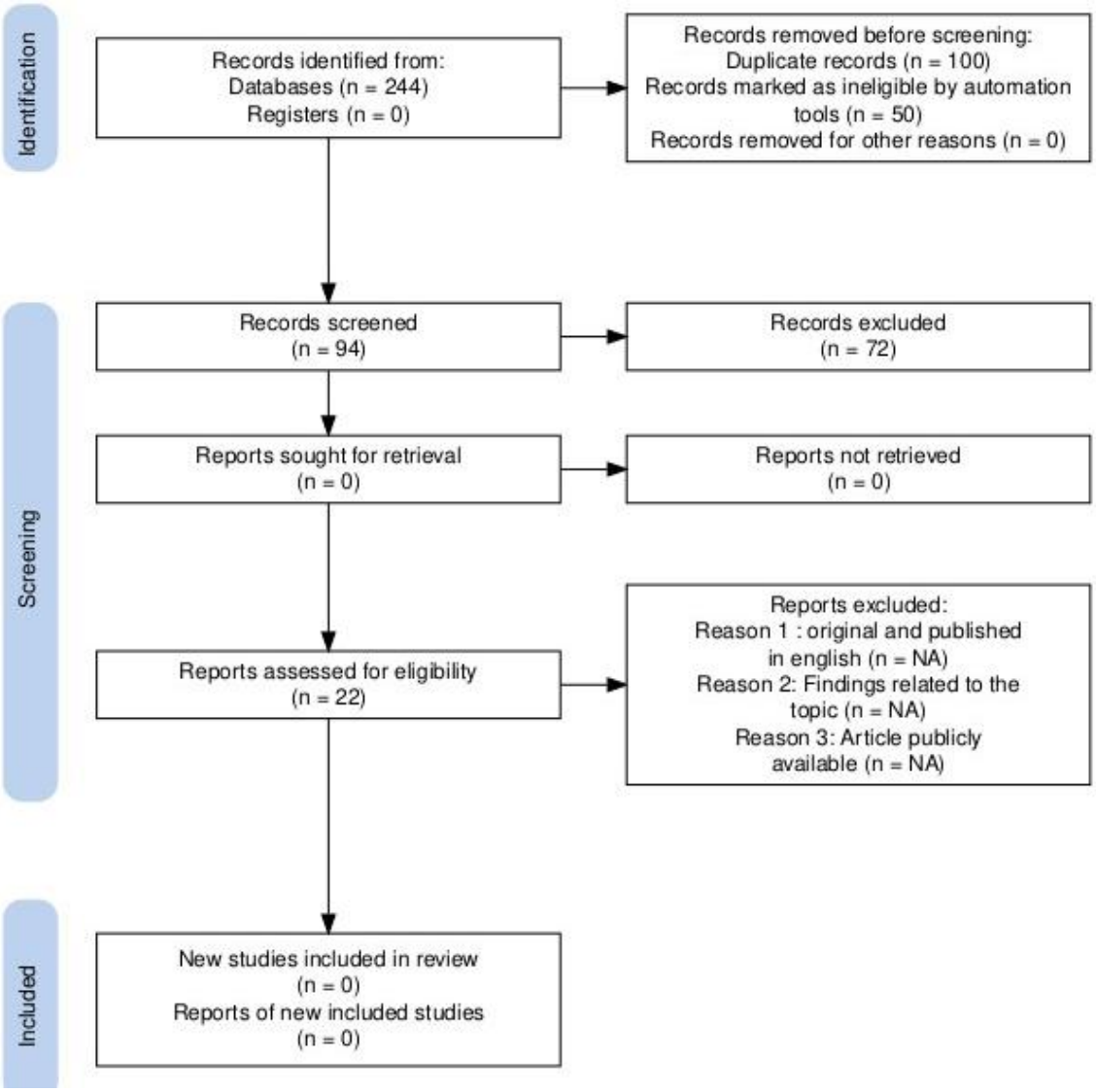

Figure 1

Diagram of the search and selection of review articles

Data analysis

A standardized data extraction process captured and coded key details from selected articles, recorded in an Excel sheet. Information included author names, research questions, frameworks, methods, findings, and limitations, enabling a thorough qualitative synthesis. Data analysis employed systematic steps, refining AI-related concepts and utilizing concept mapping to explore relationships. A systematic literature review with bibliometric analysis included problem formulation, literature search, quality evaluation, and statistical methods like regression and co-occurrence analyses (Zare et al., 2022). These methodologies ensured accurate insights into AI's role in reducing administrative burdens and enhancing instructional efficiency in middle schools.

Ethical considerations

Ethical considerations focused on privacy, copyright compliance, and plagiarism prevention. Publicly accessible data required minimal ethical approval, but permissions were sought when necessary. Privacy was ensured through secure data storage and anonymization, while copyright compliance involved understanding dataset usage terms. Plagiarism was avoided by proper APA referencing, with sources cited below all figures and tables.

Results

Classification of articles by journal

As shown in Figure 2, the classification of articles by journal highlights the interdisciplinary nature of AI research in education. Most journals (15 of 18) contributed only one article, reflecting a broad but shallow distribution of research across various venues. The Open Journal of Social Sciences stands out, contributing 14.29% of articles, possibly due to a special focus on AI in education. Creative Education follows, contributing 9.52%, indicating interest in educational innovations. Journals with single contributions, such as Review of Artificial Intelligence in Education and Computers and Education: Artificial Intelligence, feature specialized studies on reducing administrative burdens and enhancing instructional efficiency. The diversity of journals, spanning psychology, STEM education, educational integrity, and mobile learning, underscores the topic's interdisciplinary appeal. The predominance of single-article contributions suggests the emergent nature of this research field, with the potential for more concentrated journal contributions as AI's role in education continues to evolve (Figure 2).

Overview of Current Research on AI in Education

Table 1 highlights research on AI's impact on administrative efficiency and instructional effectiveness. High-impact studies like Seo et al. (2021) explore AI's role in enhancing learner-instructor interactions, a key area for instructional improvement. Similarly, Casal-Otero et al. (2023) offers foundational insights into AI literacy in K–12 education, with strong citation counts reflecting its significance. Moderately cited studies, such as Kim and Kim (2022) and Godwin et al. (2021), focus on educational psychology and teacher perceptions of AI tools, making specialized but meaningful contributions. Emerging research from 2023 and 2024, like Sanusi et al. (2023) and Nguyen et al. (2024), has lower citations due to recency but holds potential for greater impact. Studies like Majorana et al. (2022), addressing AI chatbots for administrative efficiency, highlight practical applications, while broader themes from Ghamrawi et al. (2023) stress ethical considerations and teacher leadership, emphasizing a balance between technological advancements and moral responsibilities in AI integration.

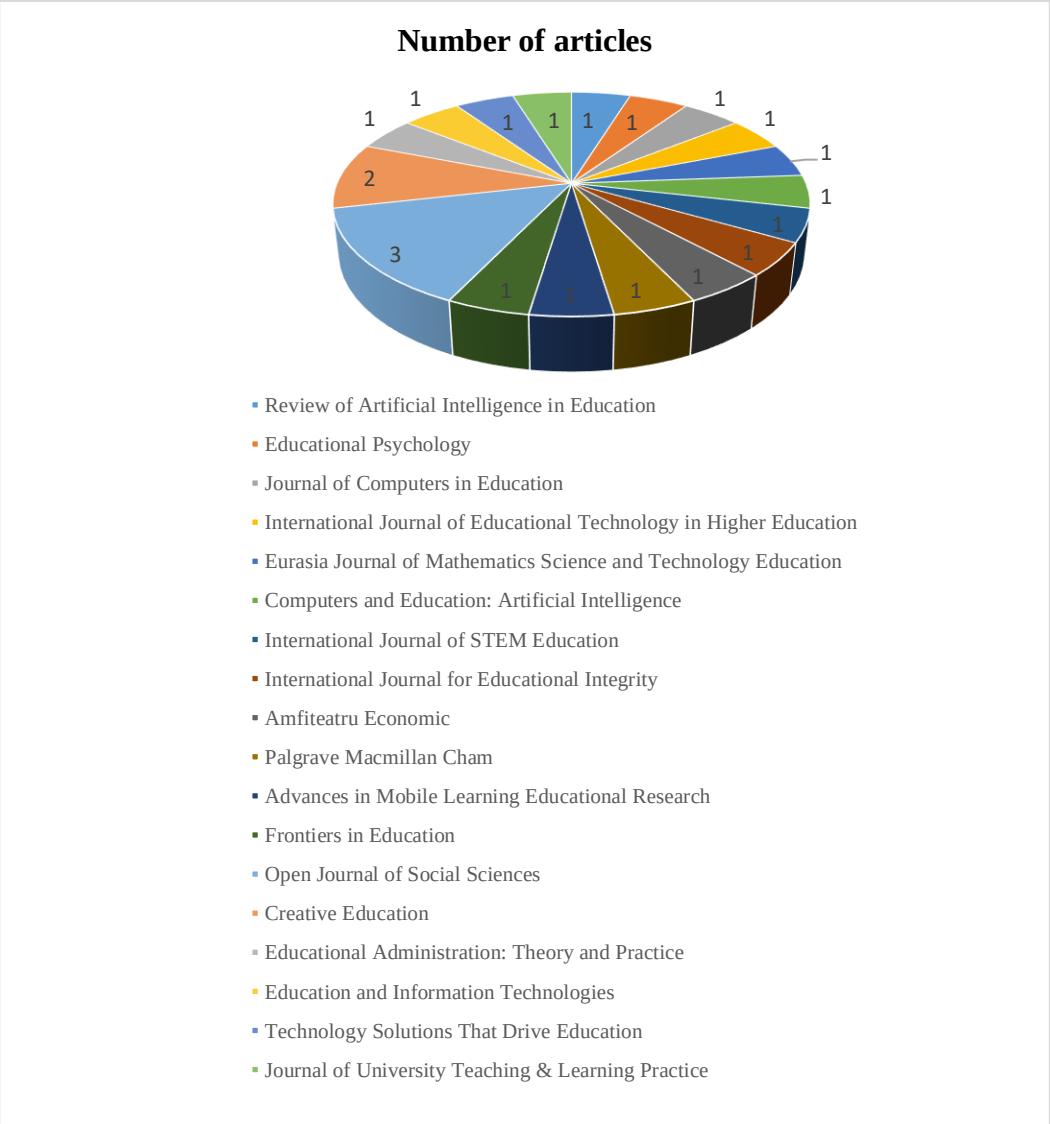

Figure 2

Distribution of research articles used across various journals

Table 1

Comprehensive Overview of AI Research in Education: Key Articles and Their Impact

Journal or Publisher name	Title of the article	Authors and year	Citations
Review of Artificial Intelligence in Education	Enhancing Administrative Efficiency in Higher Education with AI: A Chatbot Solution	Majorana et al. (2022)	0
Educational Psychology	The elusive relationship between time on-task and learning: not simply an issue of measurement	Godwin et al. (2021)	35
Journal of Computers in Education	Artificial intelligence (AI) learning tools in K-12 education: A scoping review	Yim and Su (2024)	12
International Journal of Educational Technology in Higher Education	The impact of artificial intelligence on learner–instructor interaction in online learning	Seo et al. (2021)	341
Eurasia Journal of Mathematics Science and Technology Education	Exploring the potential of artificial intelligence tools in educational measurement and assessment	Owan et al. (2023)	67
Computers and Education: Artificial Intelligence	Developing middle school students' understanding of machine learning in an African school	Sanusi et al. (2023)	8
International Journal of STEM Education	AI literacy in K-12: a systematic literature review	Casal-Otero et al. (2023)	119
International Journal for Educational Integrity	Student perspectives on the use of generative artificial intelligence technologies in higher education	Johnston et al. (2024)	9
Amfiteatru Economic	Students perceptions of the use of artificial intelligence in educational service	Djokic et al. (2024)	2
Palgrave Macmillan Cham	Students' perspective on the use of artificial intelligence in education	Caucheteux et al. (2024)	0
Advances in Mobile Learning Educational Research	Teachers' perspectives on artificial intelligence in education	Uygun (2024)	5
Frontiers in Education	Teacher's perceptions of using an Artificial Intelligence-Based educational tool for scientific writing	Kim and Kim (2022)	95
Open Journal of Social Sciences	Junior High School Artificial Intelligence Literacy: Connotation, evaluation and Promotion Strategy	Wang et al. (2023)	3
Open Journal of Social Sciences	A Review of the Application of Process Evaluation in Junior High School English Teaching under "Double Reduction"	Wang (2023)	1

Open Journal of Social Sciences	A Survey on the Current Situation of Teacher Motivation in Public Junior Middle Schools in Western China	Su and Wang (2023)	0
Creative Education	Incorporating Pre-Service Teachers and Middle School Students in Learning Advanced Integrative STEM Programs	Awad (2020)	0
Creative Education	Primary and Secondary School Teachers' Perceptions of Workload	Göksoy and Akdağ (2014)	21
Educational Administration: Theory and Practice	Impact Of AI In Education Through A Teachers Perceptive	Sangheethaa and Arun Korath (2024)	0
Education and Information Technologies	Exploring the impact of AI on teacher leadership: regressing or expanding?	Ghamrawi et al. (2023)	26
Technology Solutions That Drive Education	AI for Teachers: Defeating Burnout and Boosting Productivity	Slagg (2023)	0
Leon Furze.com	Artificial intelligence and teacher workload: Can AI actually save educators time?	Leon Furze (2024)	0
Journal of University Teaching & Learning Practice	Enhancing Student Engagement Through Artificial Intelligence (AI): Understanding the Basics, Opportunities, and Challenges	Nguyen et al. (2024)	7

Key Findings

Administrative Efficiency

Majorana et al. (2022) discuss the potential of AI chatbots in resolving recurring administrative issues and improving process efficiency. The development of AI tools for handling administrative tasks like timetable management and enrolment queries can significantly reduce the workload on educational staff, allowing them to focus on more critical tasks.

Learning Outcomes and AI Tools

According to Godwin et al. (2021), a weak and inconsistent relationship exists between learning outcomes and on-task behaviour, highlighting the need for more AI research to improve engagement. The revolutionary applications of AI in education are highlighted by Yim and Su (2024) and Casal-Otero et al. (2023), who examine a variety of AI tools and pedagogical methodologies and demonstrate how they can enhance cognitive, affective, and behavioural results through intelligent agents and collaborative learning.

AI's Impact on Learner-Instructor Interaction

Seo et al. (2021) report that AI can enhance personalized interactions at scale but also raises concerns about privacy and surveillance. The variability in acceptance highlights the need for explicit data norms and ethical guidelines.

Educational Assessment and Personalized Learning

Owan et al. (2023) discuss AI's role in automating grading and providing personalized learning experiences. The ethical challenges, including data privacy and bias, emphasize the necessity for human oversight to ensure the fair and effective use of AI tools.

Student Engagement and Understanding of AI

Sanusi et al. (2023) show that students' engagement with AI activities increases their understanding of machine learning and its applications. However, ethical concerns such as data misuse become more prominent post-intervention, suggesting the need for balanced educational programs that address AI's benefits and risks.

Teacher and Student Perspectives on AI

Johnston et al. (2024) and Djokic et al. (2024) highlight students' views on AI, emphasizing benefits, challenges, and the need for equitable access through balanced policies. Uygun (2024) and Kim and Kim (2022) reveal teachers' optimism about AI's learning potential but express concerns about its impact on teacher roles and decision transparency. These studies underscore the importance of addressing diverse needs and ethical considerations in AI's educational integration.

Ethical and Practical Concerns

Ghamrawi et al. (2023) and Nguyen et al. (2024) discuss ethical issues such as data privacy, bias, and the digital divide. These studies underscore the importance of developing robust ethical frameworks and addressing technological accessibility to ensure the equitable adoption of AI in education.

Workload and Productivity

Slagg (2023) and Leon Furze (2024) focus on AI's potential to reduce teacher workload and improve productivity. These findings suggest that AI can alleviate administrative burdens and enhance classroom dynamics, but data privacy and ethical concerns remain critical issues that must be addressed.

Discussion

Importance of Journals in Shaping AI Research in Education

The classification of articles by journal highlights the distribution and focus areas of AI research in education, particularly in reducing administrative burdens and enhancing instructional efficiency. Journals such as Review of Artificial Intelligence in Education and Computers and Education: Artificial Intelligence provide direct insights into using AI technologies to streamline administrative tasks and improve instructional methods. Interdisciplinary perspectives emerge from journals like the Open Journal of Social Sciences and Creative Education, offering diverse applications of AI in teaching practices.

Journals like Frontiers in Education focus on specific AI applications, including adaptive learning systems and automated grading, aligning with goals to reduce teachers' repetitive tasks. Ethical considerations are addressed by the International Journal for Educational Integrity, highlighting data privacy and algorithmic transparency. Regional and contextual insights from journals such as Amfiteatru Economic offer comparative analyses of AI implementation. Practical applications are detailed in Technology Solutions That Drive Education, emphasizing real-world case

studies.

Interdisciplinary Insights into AI's Role in Enhancing Educational Efficiency and Reducing Administrative Burdens

The findings highlight an interdisciplinary exploration of AI in education, focusing on reducing administrative burdens and enhancing instructional efficiency in middle schools. High-impact studies like Seo et al. (2021), with 341 citations, emphasize AI's role in improving learner-instructor interactions in online learning, while recent studies, such as Sanusi et al. (2023) and Nguyen et al. (2024), are expected to gain visibility over time. Practical applications, like AI chatbots for administrative tasks (Majorana et al., 2022) and AI's role in reducing teacher burnout (Slagg, 2023), showcase its potential for streamlining workloads. Emerging topics, including AI literacy (Casal-Otero et al., 2023) and educational measurement tools (Owan et al., 2023), reflect growing interest in foundational applications. Moderately cited studies, such as Godwin et al. (2021) on educational psychology and Kim and Kim (2022) on teacher perceptions, provide niche but valuable insights. Ethical considerations, explored by Ghamrawi et al. (2023), underscore the importance of balancing technical advancements with responsible integration. Collectively, these studies demonstrate AI's transformative role in educational practices, addressing both practical applications and broader societal concerns.

Key Findings on the Impact of Artificial Intelligence on Reducing Administrative Burden and Enhancing Instructional Efficiency in Middle Schools

The findings provide insights into the impact of AI in education, particularly in reducing administrative burdens and enhancing instructional efficiency. Majorana et al. (2022) demonstrates AI chatbots' efficiency in resolving administrative issues, aligning with Hypothesis 1 (AI tools significantly reduce the time teachers spend on administrative tasks), validating that AI tools free up time for instructional activities. Similarly, Slagg (2023) highlights AI's potential to alleviate teacher workload and enhance productivity. While these findings suggest that AI reduces administrative tasks, direct evidence linking this to improved instructional quality is limited. Godwin et al. (2021) reports a weak positive correlation between on-task behavior and learning outcomes, partially validating Hypothesis 2 (Reallocation of time improves instructional quality). Yim and Su (2024) and Casal-Otero et al. (2023) demonstrate that AI enhances cognitive, affective, and behavioral outcomes, suggesting potential improvements in student engagement. However, the connection between increased instructional time and these outcomes remains unexplored, partially validating Hypothesis 3 (Increased instructional time positively impacts performance). Teacher perspectives from Uygun (2024) and Kim and Kim (2022) indicate optimism about AI's benefits but concern over job roles and transparency, partially validating Hypothesis 4 (Teachers see AI as beneficial but remain cautious). Lastly, while studies like Majorana et al. (2022) and Owan et al. (2023) acknowledge AI tools' reliability, concerns about data privacy and occasional errors requiring human oversight persist, partially validating Hypothesis 5 (AI tools are reliable but not without flaws). Overall, the findings underscore AI's potential in education while highlighting areas requiring further investigation to strengthen its integration and effectiveness.

Addressing Limitations and Charting Future Directions for AI Integration in Middle School Education

The systematic review analyzes limitations and future research directions for AI in education. Key findings highlight several limitations, such as small sample sizes and reliance on existing data sets, limiting generalizability. Specific issues, like pandemic-related disruptions and ethical concerns, are also noted. Methodological constraints include scenario-based studies and reliance on self-reported data, suggesting the need for direct interactions and objective measures. Future research should focus on longitudinal studies, broader demographics, experimental designs, and teacher training. Ethical guidelines and cost-effective implementation models are crucial. For middle schools, expanding sample sizes, addressing ethical concerns, and comprehensive teacher training are essential for effective AI integration.

Implications of this Study

Theoretical implications

Through the integration of AI in education, this study enhances theoretical frameworks. By demonstrating how AI technologies complement teachers' jobs and increase completion efficiency, it expands on the Task-Technology Fit (TTF) Theory (Vendramin et al., 2021). Analyzing the perceived utility and simplicity of adopting AI tools for administrative and educational duties extends the Technology Acceptance Model (TAM). The results emphasize the necessity of balanced knowledge for AI integration by incorporating Technological Pedagogical Content Knowledge (TPACK) (Koehler & Mishra, 2009). Finally, the SAMR Model provides insights into educational innovation by assessing AI's revolutionary potential in instructional processes (Hamilton et al., 2016).

Practical Implications

AI tools improve administration and instruction, revolutionizing education. Automating monotonous processes improves administrative efficiency and frees teachers' time to concentrate on classroom management and one-on-one interactions (Ghamrawi et al., 2023). Better lesson planning and student involvement are made possible by this reallocation, which raises instructional quality (Kim, 2019). Additionally, AI lessens the workload for teachers, preventing burnout and increasing job satisfaction. Furthermore, AI-generated reports enhance Data-Driven Decision Making, enabling administrators and teachers to enhance procedures and results (Loureiro et al., 2022). AI improves instruction, expedites processes, and facilitates well-informed educational decision-making.

Conclusion, Limitations, and Future Research Directions

Conclusion

This study concludes that AI tools significantly reduce administrative burdens and enhance instructional efficiency in middle schools. The integration of AI allows teachers to reallocate time from administrative tasks to instructional activities, thereby improving teaching quality and student outcomes. However, concerns about AI's accuracy and potential impacts on teacher roles persist. Ethical considerations such as data privacy and the need for human oversight are crucial for effective AI implementation. Future research should focus on broader demographic studies, longitudinal impacts, and comprehensive teacher training to optimize AI's benefits while addressing its challenges

in educational settings.

Limitations

A number of limitations were noted by the review. Sample Size: A lot of research used tiny samples, which limited how broadly the results could be applied. Data Reliance: Relying solely on pre-existing data sets may obscure the difficulties involved in integrating AI into the classroom. Pandemic-Related Disruptions: Information gathered during the pandemic might not accurately reflect normal classroom circumstances. Ethical Concerns: Future AI applications must carefully address algorithmic prejudice and data privacy issues.

Future research directions

Future research should focus on critical areas to deepen understanding of AI in education. Longitudinal Studies can assess AI's long-term impact on instructional quality and student outcomes. Broader Demographics will enhance insights by including diverse groups and larger sample sizes. Experimental Designs can provide robust evidence of AI tools' causal effects. Studying Teacher Cognition will also reveal more profound insights into how AI adoption influences teaching practices and integration processes.

Conflict of Interest

No conflict of interest exists with me or my co-authors about this review article. This study was self-funded; I utilized my university's library resources and access to the AERA and other databases to support the research.

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