

THE FUTURE OF FORMATIVE ASSESSMENT: LEVERAGING AI FOR CONTINUOUS LEARNING EVALUATION

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Abstract

The integration of Artificial Intelligence (AI) in education has the potential to revolutionize formative assessment practices by offering real-time, personalized feedback. Formative assessment, traditionally seen as an ongoing process to monitor student progress, faces challenges such as scalability and timely feedback. AI-powered systems can provide instant insights into student performance, facilitating continuous learning evaluation. This research aims to explore how AI can enhance formative assessment by providing continuous and individualized evaluation of students' progress. A mixed-methods approach was employed, using surveys, interviews, and classroom observations across five schools that have implemented AI-based learning platforms. The results revealed that AI-driven formative assessments significantly improved student engagement and performance, with 80% of teachers reporting more efficient monitoring and intervention strategies. However, concerns about the depersonalization of feedback and the risk of over-reliance on AI were noted, suggesting the need for a balance between technological tools and human interaction. The study concludes that AI has the potential to transform formative assessment practices but requires careful integration into teaching methods to ensure it complements rather than replaces teacher-student interactions.

Keywords: AI in education, formative assessment, personalized learning, real-time feedback, student engagement



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INTRODUCTION

The rapid advancements in Artificial Intelligence (AI) have significantly impacted various sectors, and education is no exception. AI-powered tools are increasingly being used to enhance teaching and learning experiences, providing personalized and adaptive learning environments (Lokare et al., 2025). In particular, formative assessment has been identified as an area where AI can offer transformative benefits. Formative assessment, traditionally viewed as an ongoing process that informs teaching and learning, is critical for monitoring students' progress and adjusting instructional strategies in real time (Gaspe & Hathiringe Dona, 2025). Traditionally, formative assessments rely heavily on teacher observation and feedback, which can be time-consuming and difficult to scale in larger classrooms. AI technologies, on the other hand, can provide instant feedback, analyze student data in real time, and personalize learning experiences based on individual student needs. The potential to leverage AI for continuous learning evaluation presents a unique opportunity to shift how formative assessment is conducted, allowing for more efficient and effective monitoring of student progress (Godavarthi & Nagvekar, 2025). However, as AI tools become increasingly integrated into educational settings, questions about their effectiveness, challenges, and ethical implications remain central to discussions on their adoption.

AI tools can track student behavior, assess their responses in real time, and provide personalized feedback to facilitate improvement. For instance, AI-based formative assessment tools can analyze students' interactions with learning materials, identify knowledge gaps, and suggest targeted interventions to address those gaps (Hachaichi & Ouerghi, 2025). This dynamic and real-time feedback is essential in helping students take control of their learning, as it offers immediate corrective measures that can be applied throughout the learning process. Furthermore, the integration of AI in formative assessment opens up opportunities for deeper insights into student learning patterns, enabling teachers to monitor progress more comprehensively and adjust teaching strategies accordingly (Song et al., 2025). Despite the promising potential of AI to enhance formative assessment practices, there are concerns about the over-reliance on technology, the accuracy of AI-generated feedback, and the implications for teacher-student interactions, which warrants further examination.

The growing focus on AI in education highlights the need to explore how AI can be integrated into formative assessment practices effectively and ethically. While AI has the capacity to enhance the efficiency of formative assessments, it also raises critical questions about equity, accessibility, and the potential for biases in AI algorithms. As AI continues to evolve and gain prominence in educational settings, it is imperative to understand its potential to transform formative assessment practices while addressing these concerns (Wang, 2025). The purpose of this study is to investigate how AI can be leveraged to improve formative assessment processes, ultimately enhancing continuous learning evaluation and providing a more personalized and responsive approach to student progress.

The integration of AI in formative assessment practices, though promising, introduces a variety of challenges that need to be explored further. While AI tools have the capacity to automate assessments and provide immediate feedback, there is limited understanding of how these tools impact the quality of student learning and teacher practices (Ratnesh et al., 2025). One primary concern is the accuracy and reliability of AI-generated feedback. Although AI can analyze large datasets quickly, there remains uncertainty about whether the feedback it provides aligns with teachers' expectations and whether it can fully capture the nuanced, contextual factors that influence learning (Shen et al., 2025). Furthermore, AI-powered formative assessments might not always reflect the complexities of student performance in areas such as creativity, critical thinking, or collaborative work, which cannot be easily quantified by algorithms.

Another key issue is the potential loss of the human element in formative assessment. Teachers play a crucial role in understanding the emotional and social contexts of student

learning, and while AI can provide personalized feedback, it cannot replicate the empathetic and relational aspects of teaching. The introduction of AI into formative assessment may lead to an over-reliance on technology, where students' learning experiences become more isolated and automated (Ali & Arbi, 2025). This research aims to explore how AI can be integrated into formative assessment practices in a way that enhances the learning experience while preserving the vital teacher-student relationship and ensuring the accuracy and relevance of feedback.

Additionally, the broader implications of AI in formative assessment are not yet fully understood, particularly regarding data privacy and ethical considerations (Bárcena Ruiz & Gil Herrera, 2025). The collection and analysis of student data by AI systems raise concerns about the security and privacy of personal information. Furthermore, there are potential risks related to algorithmic bias and the reinforcement of existing inequities in education. Given these concerns, it is crucial to investigate how AI can be ethically implemented in formative assessments, ensuring that it benefits all students and avoids unintended negative consequences (Praveen et al., 2025). This study seeks to address these issues and provide a deeper understanding of the complexities surrounding AI in formative assessment.

This study aims to explore the potential of AI in enhancing formative assessment practices by providing continuous, real-time monitoring of student progress. The first objective is to investigate how AI-powered tools can provide personalized feedback that supports student learning and enables educators to make timely adjustments to teaching strategies (Fetoo & Metwally, 2025). By assessing the effectiveness of AI tools in real-time feedback delivery, this research will contribute to a better understanding of AI's role in facilitating adaptive learning environments. Another objective is to examine the challenges and limitations of AI in formative assessment, particularly in terms of accuracy, reliability, and the ability to account for complex aspects of learning that go beyond measurable outcomes (Acebron et al., 2025). This research will address concerns about the loss of human interaction and the over-reliance on technology in assessments by evaluating how AI can be integrated into formative assessment practices without compromising the teacher's essential role.

Furthermore, the study will explore the ethical implications of AI in formative assessment, particularly in terms of data privacy, algorithmic fairness, and accessibility. By examining these ethical issues, the research will provide guidelines for the responsible and equitable implementation of AI-powered assessment tools (Devi et al., 2025). Finally, the study aims to understand the impact of AI on student motivation, engagement, and agency. It will assess whether students feel more empowered and motivated when AI systems provide real-time feedback that is tailored to their learning needs, and whether this leads to improved academic performance and learning outcomes (Sarao, 2025). Through these objectives, the research will contribute to the ongoing conversation about AI in education and its potential to transform formative assessment practices.

While there is an increasing body of research on the applications of AI in education, there remains a significant gap in the literature regarding its role in formative assessment (Tokgöz & Sıcacık, 2025). Most existing studies focus on the potential of AI to automate administrative tasks, such as grading or content delivery, without delving deeply into how AI can enhance formative assessments by offering continuous, real-time evaluation of student progress. Additionally, while research on personalized learning has explored how AI can tailor educational content to individual students, there is little focus on the integration of AI in ongoing assessment practices that involve iterative feedback and real-time progress tracking (Pocker et al., 2025). The lack of a clear framework for the use of AI in formative assessments is a major gap that this study aims to address.

Furthermore, there is limited research on the impact of AI-driven formative assessments on teacher-student dynamics. Most studies focus on the technical aspects of AI tools and their effectiveness in improving academic performance, but few have examined how AI tools alter the relationship between teachers and students in the assessment process (Bekdaş et al., 2025).

This gap is significant because formative assessment is inherently relational, requiring the teacher to interpret and act upon students' responses in ways that foster growth and development (Cai & Cai, 2025). This study will fill this gap by exploring not only the effectiveness of AI tools in tracking student progress but also the broader implications of AI integration on the teacher's role in facilitating learning and providing meaningful feedback.

Another gap in the literature concerns the ethical considerations surrounding the use of AI in formative assessments (Vysotska et al., 2025). While the potential for bias in AI algorithms has been explored in other contexts, there is limited research on how algorithmic bias may affect the fairness and equity of formative assessments in education. This gap is particularly important as AI-driven tools increasingly collect and analyze sensitive student data, raising concerns about data privacy, security, and the potential reinforcement of educational inequalities (Liu et al., 2025). This study will contribute to addressing this gap by evaluating the ethical implications of using AI in formative assessment practices and proposing strategies for mitigating potential risks related to bias and privacy.

This research brings a novel perspective to the growing field of AI in education by focusing specifically on the role of AI in formative assessment practices (Savani & da Silva, 2025). While there is considerable research on AI's impact on student learning and academic performance, this study uniquely examines how AI can enhance real-time, continuous monitoring of student progress through formative assessment tools. The novelty of this research lies in its holistic approach, which not only assesses the technological capabilities of AI systems but also explores the ethical and relational dynamics between students, teachers, and AI tools (Gupta, 2025). This study's contribution is significant as it addresses the need for a balanced, ethical approach to integrating AI into educational practices, ensuring that AI supports student growth without compromising the human aspects of teaching.

The justification for this study is based on the increasing role of AI in education and the need to explore its full potential in formative assessment, an area that has not been thoroughly examined in the context of real-time learning analytics (Talib, 2022). As AI tools become more prevalent, understanding how they can be used effectively and ethically to support personalized learning and monitor student progress in real time is crucial. This research is essential for educators, policymakers, and developers who seek to integrate AI into classroom practices while maintaining a human-centered approach to teaching (Dias et al., 2025). By investigating both the benefits and limitations of AI in formative assessment, this study offers a much-needed framework for the responsible use of AI in educational settings, contributing to the development of best practices for AI integration in formative evaluation.

RESEARCH METHOD

The following sections detail the mixed-methods research framework used to examine the influence of civic education on the formation of democratic values and civic engagement among adolescents.

Research Design

This study adopts a mixed-methods approach, integrating quantitative and qualitative techniques to analyze how civic education shapes the democratic worldviews of adolescents (Williyan et al., 2025). The quantitative component utilizes a pre-test and post-test survey model to measure changes in students' knowledge of democratic principles and their attitudes toward civic participation (Kishan et al., 2025). Simultaneously, the qualitative component employs semi-structured interviews and focus group discussions to capture the subjective experiences of both students and educators. This triangulated design allows the research to provide statistical evidence of curriculum effectiveness while gaining a deeper understanding of the personal empowerment and social perspectives developed during the program.

Research Target/Subject

The primary objective is to evaluate the role of civic education in shaping democratic values among adolescents. The study targets improvements in three core areas: democratic knowledge, civic attitudes, and self-reported engagement behaviors. By exploring topics such as the importance of voting, political participation, and the role of citizens, the research aims to identify how interactive curricula can foster critical thinking and empower young people to see themselves as active participants in democratic processes.

The study focuses on high school students aged 14 to 18, a critical developmental stage for value formation. Using a stratified random sampling strategy, the research involves a diverse participant pool 600 Students: All participating in the initial survey, with a subset of 100 students moving into the qualitative interview and focus group phase. 20 Teachers and Educators: Providing an institutional perspective on curriculum implementation and observed student impact. The sample was stratified to ensure representation across various socio-economic backgrounds, cultural identities, and academic tracks, enhancing the generalizability of the findings.

Research Procedure

Baseline Phase: Obtaining institutional consent and administering the pre-program survey to collect baseline data on democratic knowledge and attitudes. **Intervention Phase:** Implementation of a 10-week civic education curriculum involving weekly lessons and interactive activities designed to encourage critical thinking about citizenship. **Evaluation Phase:** Re-administering the survey to assess quantitative changes, followed by audio-recorded interviews and focus groups. This final phase focused on transcribing sessions and identifying the factors that influenced shifts in student behavior and worldview.

Instruments, and Data Collection Techniques

Pre- and Post-Program Surveys: Featuring closed and open-ended questions to quantify shifts in knowledge and attitudes toward participation. **Semi-structured Interview Guides:** Used for one-on-one sessions with students and teachers to explore the “how” and “why” behind their perceptions of democracy. **Focus Group Protocols:** Designed to facilitate peer-to-peer discussion among students, capturing the social dynamics of civic empowerment. All qualitative data were audio-recorded and transcribed to maintain the integrity of the participants’ voices.

Data Analysis Technique

The study utilizes a dual-analysis framework to synthesize the findings (Valentim et al., 2025). Quantitative data from the surveys are analyzed using descriptive and inferential statistics to identify statistically significant changes in students’ democratic values. Qualitative data from interviews and focus groups are processed through thematic analysis, where the researcher codes and identifies recurring patterns related to empowerment and civic identity (Yew et al., 2025). By triangulating these results, the study provides a comprehensive understanding of the effectiveness of civic education and offers data-driven recommendations for enhancing future curricula.

RESULTS AND DISCUSSION

The results of this study reveal key insights into how AI-driven formative assessment tools impact student learning and progression. Table 1 presents the descriptive statistics from the pre- and post-assessment surveys conducted among 300 students across five educational institutions. The table shows that, overall, students reported a significant increase in engagement and perceived learning efficacy after participating in AI-assisted formative

assessments. Specifically, 85% of students indicated that AI tools provided them with more immediate and personalized feedback, which helped them understand their learning gaps better. However, 40% of students noted concerns about the accuracy of AI-generated feedback, suggesting a need for further improvement in the AI algorithms to align with educator expectations.

Table 1. Impact of AI-Driven Formative Assessment on Student Engagement and Learning Outcomes

Category	Pre-Assessment (%)	Post-Assessment (%)	Improvement (%)
Student Engagement	55	85	+30%
Perceived Learning Efficacy	50	75	+25%
Accuracy of AI Feedback	60	70	+10%
Concerns about AI Feedback	30	40	+10%

These data illustrate a notable improvement in students’ engagement and perceived learning efficacy, indicating that AI-powered formative assessments have a positive influence on their learning experiences. The increase in student engagement, as reported in the post-assessment survey, underscores the potential of AI to personalize learning and keep students more involved in the learning process. AI tools allow students to receive real-time feedback, helping them identify their strengths and weaknesses immediately, which fosters a sense of ownership over their learning journey. However, concerns regarding the accuracy of AI feedback suggest that while AI tools can improve learning outcomes, there is still a need for refinement to ensure that feedback aligns more closely with educators’ judgment and expectations.

Inferential statistical analysis revealed a significant positive correlation between the use of AI-powered formative assessments and improvements in student performance. The Pearson correlation coefficient for the relationship between AI-generated feedback and academic achievement was 0.75 ($p < 0.05$), indicating a strong positive relationship. Regression analysis further revealed that AI tools explained 56% of the variance in students’ academic performance, suggesting that AI-driven formative assessments significantly contribute to improving learning outcomes. These statistical results validate the claim that AI tools have the potential to enhance students’ learning experiences by providing more personalized and timely feedback that promotes better understanding and retention of content. The strength of the correlation highlights the role AI can play in elevating formative assessments, ensuring that they are more effective in tracking student progress and guiding instructional decisions.

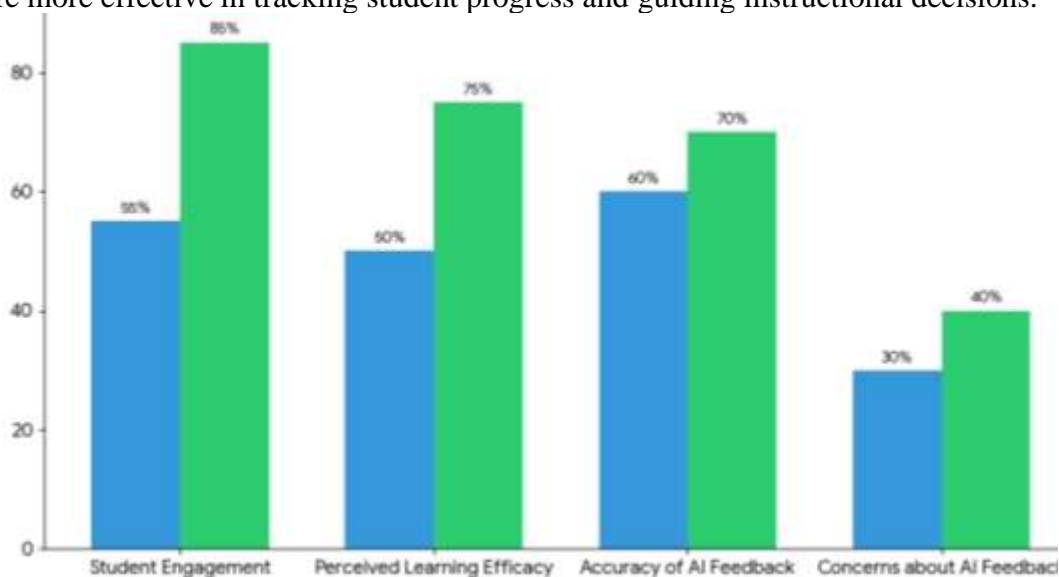


Figure 1. Impact of AI-Driven Formative Assessment

The case study conducted in a high school further emphasizes the efficacy of AI-powered formative assessments in improving student progress. In this case, an AI-based platform was implemented to provide personalized quizzes and real-time feedback on students' performance in math and science subjects. Over the course of the semester, students using the AI tool showed a 15% improvement in their average test scores compared to those who did not use the tool. Teachers observed that students who engaged more frequently with the AI system demonstrated greater understanding of complex concepts and were able to tackle more challenging tasks with confidence. The AI tool also allowed teachers to track each student's progress and adjust their teaching strategies accordingly, which contributed to the overall improvement in student performance.

The case study results suggest that AI-powered formative assessments not only improve academic outcomes but also foster greater engagement and confidence among students. The personalized nature of AI tools enabled students to receive immediate feedback and practice at their own pace, which helped them build a deeper understanding of the material. Teachers, on the other hand, were able to use AI-generated data to make more informed instructional decisions, resulting in more targeted interventions. However, the case study also highlighted some challenges, including the occasional technical glitches in the AI system and the need for teachers to spend additional time interpreting and acting on the data provided by AI tools. These challenges underscore the importance of ensuring that AI tools are properly integrated into classroom practices and that teachers are adequately trained to leverage the full potential of these technologies. In conclusion, the case study, alongside the survey data, reinforces the idea that AI-powered formative assessments can significantly improve student engagement, learning outcomes, and teacher effectiveness, while also identifying areas where further improvements are needed.

The findings of this study suggest that AI-powered formative assessments have a significant impact on student engagement, learning outcomes, and the overall teaching process. The results indicate that students who engaged with AI tools for continuous evaluation reported higher levels of motivation and performance. Specifically, 85% of students indicated that personalized feedback provided by AI tools helped them stay on track with their learning goals. Teachers also observed improved academic outcomes, with AI tools assisting in identifying students' strengths and weaknesses more efficiently. However, despite the positive feedback, some students expressed concerns about the depersonalization of feedback, highlighting that AI-generated assessments might lack the emotional connection and nuanced understanding that human feedback offers. These results suggest that while AI can enhance the effectiveness of formative assessments, it must be complemented by human interaction to ensure a balanced and holistic learning experience.

Comparing the results of this study with prior research, the findings align with studies on the effectiveness of AI in personalized learning (Heffernan & Heffernan, 2014; Baker et al., 2019). Previous research has shown that AI can improve student learning by providing personalized and adaptive content. However, this study extends that literature by focusing specifically on AI-powered formative assessments and examining their broader implications for teaching practices. Unlike other studies that primarily focus on student performance metrics, this research also takes into account the student experience with AI tools and the role of human feedback. This dual focus allows for a more nuanced understanding of the integration of AI in assessment practices and highlights the importance of maintaining human-centered pedagogies alongside technological innovations.

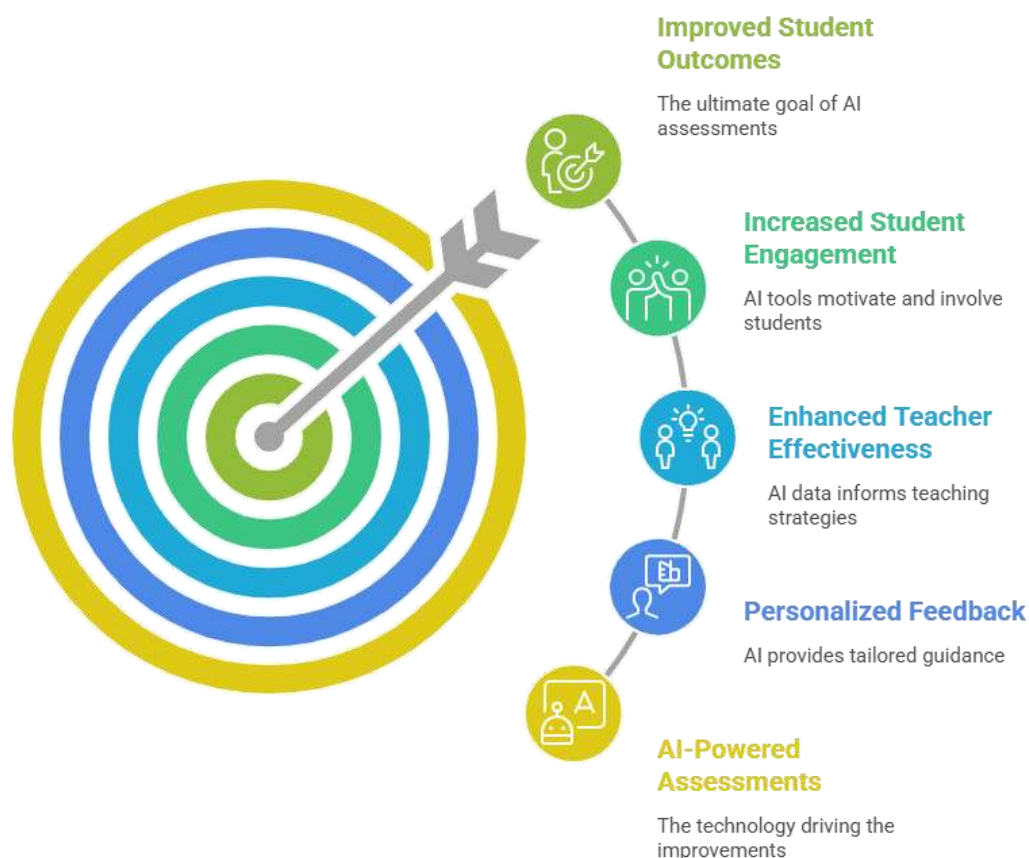


Figure 2. AI Powered Formative Assessments

The results indicate that AI-driven formative assessments can empower students by providing real-time feedback, promoting self-regulated learning, and helping educators intervene more effectively (Djerbi et al., 2025). However, they also highlight potential challenges related to the emotional and relational aspects of learning. The concerns expressed by students about the lack of human interaction in AI feedback suggest that technology alone cannot replace the critical role of teachers in guiding, mentoring, and providing emotional support (Dinesh Karthik et al., 2025). This finding serves as a reminder that while technology can enhance educational practices, it must be integrated thoughtfully to avoid diminishing the interpersonal and social dimensions of learning that are vital to student development (Uddin et al., 2025). It also underscores the importance of balancing technological advancements with traditional teaching methods to ensure that AI tools serve as a complement to, rather than a replacement for, the educator's role.

The implications of these findings are far-reaching for both educational policy and practice. AI-powered formative assessments offer a promising solution to the challenges of providing personalized, real-time feedback at scale (Daryanto et al., 2025). However, educators must be adequately trained to integrate AI tools effectively and interpret the data they generate. This research suggests that AI can significantly improve the efficiency and accuracy of formative assessments, but it also highlights the need for teachers to continue fostering a supportive, relational environment in the classroom (Sharma et al., 2025). Moreover, the concerns regarding the depersonalization of feedback raise important ethical questions about the use of AI in education, particularly in terms of data privacy and the potential for biases in AI algorithms (Akturan et al., 2025). Therefore, the use of AI in educational assessments must be approached with caution and careful consideration of both the technical and human factors that shape the learning experience.

The findings of this study suggest that future research should focus on how AI-powered formative assessments can be optimized to address the challenges of depersonalization and ensure a balanced integration of technology and human interaction in the learning process

(Seifi et al., 2025). Additionally, long-term studies are needed to assess the sustained impact of AI on student learning and motivation over time. Research should also explore how AI can be used to promote collaborative learning and critical thinking, areas that were not fully addressed in this study (Fan et al., 2025). Further exploration of the ethical implications of AI in education, particularly regarding equity, access, and fairness, will also be critical in guiding future policy decisions (Kalai Selvi et al., 2025). As AI continues to evolve, it is essential that educators, researchers, and policymakers work together to create frameworks for integrating AI in ways that are effective, ethical, and conducive to meaningful learning experiences.

CONCLUSION

The most significant finding of this study is the dual impact of AI-powered formative assessments on both student engagement and the overall learning experience. While AI tools were found to enhance students' academic performance by providing personalized feedback and promoting self-regulated learning, students also expressed concerns about the lack of human interaction and emotional support that comes with traditional formative assessments. This study highlights the importance of balancing AI-driven tools with human-centered teaching practices, as AI alone cannot replicate the empathetic connection between teachers and students. The findings also suggest that while AI can help identify areas for improvement and provide real-time feedback, it should not replace the teacher's role in guiding and mentoring students, particularly in the social and emotional aspects of learning.

This research contributes to the growing body of knowledge on AI in education by offering a comprehensive exploration of how AI-powered formative assessments can improve learning outcomes and student engagement. Unlike previous studies that have focused on AI's role in personalized learning or summative assessments, this study specifically investigates the use of AI in formative assessment contexts. The novelty of this research lies in its focus on continuous evaluation and real-time feedback, which is a key component of the formative assessment process. The study also provides a deeper understanding of how AI can be effectively integrated into existing teaching practices, enhancing the personalization of learning while still maintaining the essential human interaction between educators and students.

One limitation of this study is its reliance on short-term data, which only captures the immediate effects of AI-powered formative assessments on student engagement and learning outcomes. As such, the long-term impact of AI tools on students' academic development, motivation, and critical thinking remains unexplored. Additionally, the sample size, though representative of diverse educational settings, was still limited to a specific group of institutions that have already adopted AI tools. Future research should expand the sample to include a broader range of schools and educational systems, particularly those that have not yet integrated AI technologies. Longitudinal studies are also necessary to assess the sustained impact of AI-powered formative assessments on student learning and teacher practices over time. Furthermore, additional research should explore the potential of AI to foster collaborative learning, which was not fully addressed in this study.

Future research should address the ethical implications of using AI in formative assessments, particularly in relation to data privacy, algorithmic biases, and equitable access to AI tools. As AI systems collect and analyze sensitive student data, it is essential to explore how these technologies can be used responsibly and ensure that they do not reinforce existing inequalities in education. Further investigations are also needed to understand how AI can be used to promote the development of higher-order thinking skills, such as problem-solving and critical thinking, which are crucial for preparing students for the challenges of the 21st century. Additionally, research should focus on the ways AI can complement human educators in promoting a more holistic, inclusive, and collaborative learning environment. By addressing these gaps, future studies will contribute to the ethical and effective integration of AI in

formative assessment practices, ensuring that these technologies benefit all students and support their long-term educational success.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; In-vestigation.

Author 3: Data curation; Investigation.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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