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AI-Supported Formative Assessments: Enhancing Student-Centered Learning and Teacher Perceptions

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ABSTRACT

This study evaluates the effectiveness of AI-supported formative assessments in student-centered learning. Using a reliable questionnaire with a Cronbach's alpha of .854, the research explores teachers' views on AI tools and their impact on formative assessment practices. The findings reveal a generally positive attitude among educators, with an average score of 92.79 and a moderate standard deviation of 9.03, indicating a strong appreciation for AI's role in data collection, analysis, and the creation of innovative assessment tasks. However, the variability in responses points to differing levels of familiarity and perception regarding AI. Interestingly, there were no significant differences in opinions among teachers from public, private, or UNRWA schools, suggesting that factors beyond the type of school play a role in shaping perceptions of AI in formative assessment. Ethical concerns also emerged, including issues related to data privacy, intellectual property, and the potential effects on critical thinking skills. These concerns underscore the necessity for robust data protection policies, ethical guidelines, and comprehensive educational training to mitigate risks and foster responsible AI use. The study concludes that while AI has the potential to greatly enhance formative assessments by boosting efficiency and offering valuable insights, its integration must be approached with careful attention to ethical considerations and academic integrity. Establishing clear guidelines and training programs is crucial for effectively utilizing AI in a student-centered learning environment.

Keywords
Academic Integrity
Artificial Intelligent
Ethical Consideration
Formative Assessments
Student-Centered Learning

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Introduction

In recent years, there has been a growing interest in how technology, particularly artificial intelligence (AI), can enhance education. AI tools and formative assessments are increasingly viewed as key components of a student-centered learning environment, where the focus is on tailoring education to meet the individual needs and pace of each student. This shift in education paradigms is underpinned by the recognition that traditional, one-size-fits-all methods often fail to engage students fully or address diverse learning styles [1]. Formative assessments, designed to provide ongoing feedback and support, align well with AI's capability to analyze vast amounts of data and provide real-time, personalized insights for students and educators [2]-[4]. These AI assessment tools have the potential to create more adaptive learning experiences that promote student agency, motivation, and ultimately, better learning outcomes [3],[5].

Research suggests that the integration of AI in formative assessments not only supports individualized learning but also enhances teacher efficacy by providing data-driven insights into student performance. AI tools like intelligent tutoring systems (ITS) have been shown to help teachers make informed decisions on adjusting instructional strategies in real time, fostering a more dynamic and responsive learning environment [6],[7]. As educational systems continue to evolve, understanding the intersection of AI and formative assessments is critical to designing learning environments that prioritize student-centered approaches and equip students with the skills they need for future success [8].

This study explores the effectiveness of AI and formative assessments in facilitating a student-centered learning environment. Specifically, the study seeks to determine how AI tools impact the efficiency, creativity, and accuracy of formative assessments, and to assess teachers' perceptions of these tools across different educational settings. Additionally, the research aims to address ethical considerations related to the use of AI in educational assessments, such as data privacy, intellectual property, and the potential effects on critical thinking skills.

The main purpose of this study is to determine whether AI-supported formative assessments can help create a student-centered learning experience. More precisely, this research will examine how AI tools affect the productivity, innovation, and correctness of formative assessments, as well as teachers' attitudes towards these tools in various

educational environments. The research also explores the ethical issues of using AI in testing in education, including privacy of data, ownership of intellectual property, and the impact on critical thinking ability.

(RQ1) Can AI-supported formative assessment be used in the classroom? This question is about how the use of AI tools will change the entire evaluation process, specifically with formative evaluations becoming easier and better. (RQ2) How do teachers feel about AI tools in formative assessment, and do these feelings change when comparing public, private, or The United Nations Relief and Works Agency (UNRWA) schools? This research question is to determine and analyze the opinions of teachers on AI instruments in different teaching environments and see if there are any similarities or differences in their responses. (RQ3) How can AI tools be integrated into formative assessments in a way that supports rather than replaces teacher expertise and critical thinking? This question explores how best to integrate AI into the formative assessment process without compromising the necessity for human judgment and interaction in teaching. (RQ4) What ethical issues arise from the use of AI in formative assessment, and what are the implications of this use for data privacy, intellectual property, and the originality of student work? This question delves into the ethical issues of AI tools and how there must be certain guidelines and policies in place to prevent the abuse of these tools.

Literature Review

A. Formative assessment in student-centered learning

Formative assessment is a crucial element of student-centered teaching, a pedagogical method that stresses the active role of students in their learning. Formative assessments are supposed to give students real-time feedback, making it possible for them to see their learning progress, pointing out the areas that need improvement, and keeping them active in their educational path [9],[10]. Moreover, in student-centered learning, formative assessment assists the teachers in adapting their instruction to the individual learners' requirements thus leading to student trust, responsibility, and self-regulation [11] cannot be overlooked [12].

Besides, formative assessment serves as a core part of student-centered education by continuously monitoring the students' advancement and giving them feedback instantly, making the instructions suitable for their individual needs. Formative assessments do not require the students to fix their learning at the end of a period, as the assessments are ongoing and the educators and learners are in control of the process of changes during the learning process [13]. AI is a form of formative assessment that speeds up data collection, analysis, and feedback. Educators who use adaptive learning tools and AI-driven analytics are capable of giving feedback that is specific to certain learning gaps thus molding a more effective and

individual learning experience, further, AI can track students' performance in real-time, offering insights that guide instruction and support differentiated learning [3]. This integration of AI not only makes the process more efficient but also empowers students to take greater ownership of their learning journey.

B. Bridging learning gaps through formative assessment

AI and formative evaluations are a significant source of help for teachers to get to know the gaps in the learning of students and adjust their learning work to the learners' needs. The potential by which AI algorithms can analyze student performance data on a continuous basis and, in particular, the convenience of detecting the very precise points at which students are interested, is a powerful means to find out how well the students are, offering real-time insights into their understanding. The ability of these tools to utilize speed and real-time analysis to recognize hidden patterns is indicated by traditional assessment methods [3],[4],[14]. In conjunction with this, AI may also organize custom feedback and recommend directed interventions, which will then enable teachers to make suitable adjustments to their teaching styles [8],[15]. This approach contributes to the student's personalization of their studies and ensures that each student gets the support they need and that the contributions they bring are valued, making the interactions meaningful. Such skills are learned when they are adapted to the learner's specific needs in a student-centered educational environment.

C. Ethical implications of AI in formative assessment

The use of AI in formative assessment leadership has a lot of ethical considerations, one of which is data privacy which is directly connected with human individual freedom. One notable concern is the acquisition and safeguarding of most private student data, which probably will lead to potential data leaks and abuse of the same if not protected by strong measures [16],[17]. Besides, AI technology can increase the chance of data sharing and storage errors that can in turn cause discrimination of certain social groups and we risk obscuring student autonomy with the restricted options for self-learning [5],[18]. Thus, making sure that strict data protection schemes and giving clear guidelines to AI algorithms will be definitely of paramount importance in maintaining moral standards in a learning system.

Material and Methods

A. Research model

The research model of this study involves a mixed-methods approach with a quantitative tool, and a questionnaire, for data collection, it also focuses on diverse participants from different types of schools. This approach has proved to be a valid way to collect and analyze data (see Mousa & Molnár, 2019a). The model is framed within the context of training and practical application, with a strong emphasis on ethical practices surrounding AI use in

education. The designed framework enables this study to explore how AI impacts formative assessments across various subjects in different educational settings.

B. Research sample

The sample for this study comprises 24 teachers, including 18 females and 6 males, selected from three distinct types of educational institutions: 17 public school teachers, 5 private school teachers, and 2 UNRWA school teachers. All participants are educators in the STEM fields and English as a Foreign Language, encompassing various subject specializations. Within this group, there are 9 science teachers, 7 teachers specializing in English as a Foreign Language (EFL), and 8 mathematics teachers. This wide range of participants was selected to capture a comprehensive picture of how formative assessment techniques are used across different schools and subjects, particularly in STEM education and language instruction.

The sampling method followed a purposive approach, ensuring the inclusion of educators from diverse educational institutions and subject specializations. Participants were selected based on their expertise in formative assessment practices and their willingness to engage in AI-integrated educational research. This approach was chosen to maximize the relevance and depth of the study by incorporating educators actively involved in both teaching and research. By selecting teachers from different school types and subject areas, the study aims to provide a well-rounded perspective on the role of AI in formative assessments across varied educational settings.

C. Data collection tools and procedure

This research utilized a structured questionnaire as its main data collection tool, which was given to all participating teachers. These participants are in-service teachers currently enrolled as postgraduate researchers in the Master of Arts in Teaching (MAT) program at Al-Quds Bard College. The survey was carefully constructed to include six categories that are all relevant to artificial intelligence in education. The first section Awareness and Familiarity with AI Tools explores the participants' knowledge and understanding of various AI tools available for educational purposes. The second, Integration of AI in Research investigated how teachers incorporate AI into their research practices and classroom activities, providing insights into current application trends. The third, Perceived Benefits and Drawbacks focused on the participants' views regarding the potential advantages and challenges of using AI in educational settings, aiming to uncover both positive impacts and areas of concern. The fourth, Future Trends and Recommendations gathered opinions on the anticipated developments in AI technology and its role in future educational practices, encouraging teachers to suggest ways to enhance AI integration. The fifth, Barriers to Adoption and Mitigation Strategies, discussed the obstacles that teachers would have to AI tools and their recommendations for

those hurdles. The last section Collaboration and Knowledge Sharing delved into the extent of collaboration among teachers when using AI tools, as well as how they share knowledge and experiences with colleagues. This extensive survey was created to obtain an overall perspective of the teachers' opinions, exposures, and suggestions about AI in the classroom.

The participating teachers were actively engaged in their research projects, which entailed them creating teaching activities and assessment instruments to use in their schools. As part of this process, the teachers underwent training focused on the safe and ethical use of artificial intelligence (AI) in educational settings. This training emphasized adherence to the academic honesty policy upheld by Al-Quds Bard College (AQB), ensuring that all applications were used responsibly and in line with ethical research standards. During the training, teachers learned about various AI tools and how to integrate them effectively into their research while maintaining data integrity and student privacy. It was imperative that this training be provided to equip the teachers with the ability to use AI in the formative assessments, yet still follow the moral codes that accompany academic research. Then the teachers used their new AI-based assignments and exams in their classrooms, and thus their experiences offered real-world feedback on AI in education.

D. Data analysis

The data collected in this study were analyzed using both quantitative and qualitative methods. Given the structured nature of the questionnaire, quantitative data were analyzed using descriptive statistics to summarize the responses of participating teachers. Additionally, reliability analysis (Cronbach's alpha) was used to ensure that the items within each category consistently measured the intended constructs. Furthermore, differences between groups were analyzed by computing average awareness scores based on school type and subject area, using statistical methods such as ANOVA and t-tests.

For the qualitative data analysis, responses to open-ended questions were analyzed using thematic analysis. This involved a systematic coding process where responses were categorized into emerging themes. Initially, open-ended responses were reviewed to identify recurring patterns and ideas. The coding process followed an inductive approach, where codes were generated based on the content of the responses rather than pre-defined categories. Sample responses were examined to highlight key themes, such as perceived challenges in AI adoption, ethical concerns, and innovative AI applications in formative assessments. To ensure consistency and reliability in coding, two independent researchers reviewed and refined the themes before finalizing the qualitative findings.

E. Ethical

Informed Consent: the teachers who participated in the data collection were informed about the research and they likely provided informed consent. This ensures that participants

understand the purpose, methods, and potential impacts of the study before agreeing to take part.

Confidentiality and Privacy: The study ensures that the data collected, especially personal or sensitive information about the teachers or their students, is handled confidentially. Maintaining the privacy of both teachers and students is essential in this study since it involves AI in educational settings.

Data Integrity and Academic Honesty: The teachers received training that emphasized the importance of adhering to academic honesty policy at the institution where they are studying (AQB), especially concerning AI tools. This focus on honesty ensures that data is collected and reported accurately without manipulation or misrepresentation, which is essential for the ethical use of AI and research. In addition, participating teachers receive training on the ethical use of AI tools, ensuring they understand how to integrate these tools in ways that respect both the research process and their students' status.

Results

A. Descriptive statistics and reliability analyses

In general, the study shows that the instrument was reliable for measuring those constructs. Cronbach's alpha ($\alpha = .854$) suggests a high level of internal consistency among the items in the questionnaire, meaning that the questions were well-aligned and measured a cohesive underlying concept. In general, a Cronbach's alpha value above 0.7 is considered acceptable, and values above 0.8 are considered good, further confirming the reliability of the instrument used in this study (RQ1).

The mean score ($M = 92.79$), and standard deviation ($SD = 9.03$) deliver a global view of the responses from respondents over the entire six choices. The higher the mean, the better on average respondents feel for that item, and the higher the standard deviation shows greater variability in responses. A standard deviation of 33.44 characterizes a medium distribution around the average (most scores were close to the mean) but there was some variability in participants' responses. This variability may indicate a variation in terms of the awareness, acquaintance, or attitudes toward integrating AI in formative assessment among the participants, which can serve as an important input for further investigation and discussion in the study (RQ1).

Analysis results show that the (p-value=0.198) which means there is no statistically significant difference between the responses of public, private, and UNRWA school teachers. The mean scores for the public, private, and UNRWA school levels were closer (M_public=91.52, M_private=96.0; M_UNRWA=95.50, F= .549 p>.001; r=.349, p>.001). A one-way ANOVA test was carried out to compare the groups, but it showed a low F-value which means that there

are no significant differences for these parameters among the groups. Additionally, the correlation coefficient ($r = .349$, $p > .001$) suggests a weak relationship that is not significant. Overall, these findings imply that the type of school where teachers work does not have a considerable impact on their responses regarding the use or perceptions of AI in formative assessment. This lack of significant difference suggests that factors other than the school type may be more influential in shaping teachers' views and practices in AI-supported assessment (RQ2).

B. Formative assessment enhancement

On whether they believe that AI tools could revolutionize traditional research methods, the teachers responded to overwhelmingly positive overall views on how powerful and useful AI can be in transforming traditional research activities into a laundry list of potential benefits and applications see Fig. 1. Time Saver and Efficiency are recurrent in the responses. One common response was AI reduces a significant amount of time in finding, organizing, and categorizing information into thematic analysis. From a formative assessment standpoint, this implies that AI can improve upon the traditional method of data collection and analysis by automating certain aspects and offering information on student performance more quickly so that teachers may respond to their students accordingly.

Another important benefit mentioned is AI's role in overcoming writer's block and facilitating idea generation. One of the answers highlighted how AI can help overcome writer's block and make the writing process more accessible, while another pointed out AI's ability to generalize ideas and offer new perspectives. For formative assessment, this implies that AI could assist teachers in designing more creative and varied assessment tasks by suggesting different approaches and content ideas, thereby enhancing the quality of assessments.

The ability to perform advanced data analysis and visualization is also considered a key benefit of AI. Some Teachers expressed their views that AI can do complex data analysis work like making charts, suggesting frameworks, and telling a huge amount of data with an accuracy one. This suggests that AI has a role to play in the enhancement of formative assessment by facilitating better data analysis for learning analytics, recognizing patterns of learning, and offering an in-depth understanding of student progression.

AI's role as a research and organizational tool was another highlight. One of the participants compared AI to a research engine that not only finds information quickly but also assists in categorization and theme identification. Similarly, another mentioned AI's usefulness in managing references, summarizing sources, and offering frameworks for evaluating research results. In formative assessment, these capabilities could translate into more organized and systematic assessment processes, where AI helps manage and analyze student performance data, leading to more precise and informed feedback.

Some others also pointed out that AI was capable of extending traditional research approaches and intellectual horizons. This paves the way for AI to revolutionize traditional formative assessment practices and bring about innovation, critical thinking, and differentiation in various teaching contexts.

Overall, the responses suggest that teachers see AI as a valuable tool for the research process, enhancing efficiency, and assisting in data analysis and organizing. When applied to formative assessment, these findings suggest AI has the potential to significantly change assessment practices, allowing for quicker data processing and new ideas on how feedback can be given or innovative ways to generate tasks that will offer a truer image of performance as well as allowing a more seamless way of tracking progress using data. However, some responses also caution against relying entirely on AI, advocating for a balanced approach where AI enhances rather than replaces teacher expertise (RQ3).

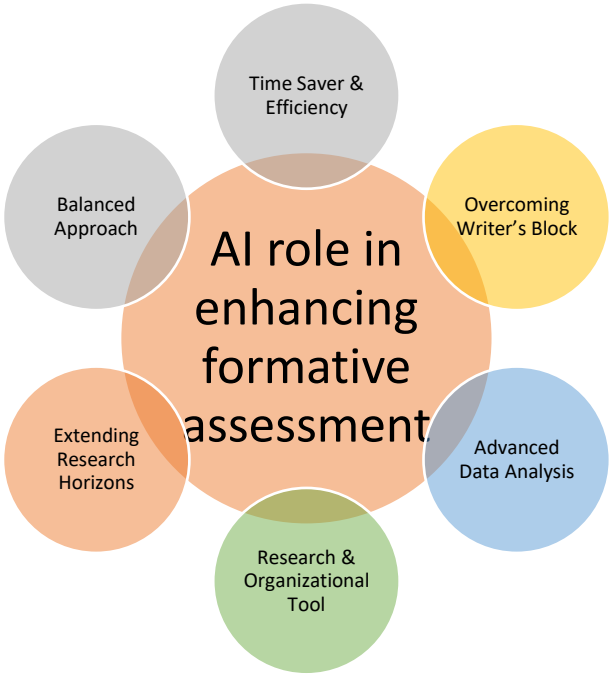


Fig. 1. Key Insights from Teachers on AI's Potential in Research and Formative Assessment

C. Ethical implications of AI in education

The responses reveal a range of concerns and perspectives around the ethical extent to which educators can utilize AI tools in research when it comes to formative assessment. Most of these concerns are related to data security, ownership of data, or the authenticity of research, and its effects on critical thinking (see Fig. 2).

Some teachers express concerns about AI's reliance on large datasets, which may be private or protected intellectual property. Related in this case to formative assessment, these concerns extend to broader ethical inquiries regarding how AI systems gather, retain, and

analyze data from students. That implies that while AI can provide effective assessment tools, educators are aware of the importance of student privacy and the misuse of individual data. It is a timely reminder of the need to ensure solid privacy and data protection measures are in place when applying AI in educational assessments.

Others worry that over-reliance on AI for tasks like summarizing texts or drawing conclusions might interfere with researchers' ability to engage in critical thinking and independent analysis. Similarly, some feel that using AI can overshadow personal effort in research. These responses suggest that while AI can enhance formative assessment by providing insights and recommendations, there is a potential drawback if teachers or students begin to rely too heavily on AI, thereby diminishing their critical engagement with the material. This highlights a key consideration for educators: AI should serve as a supportive tool rather than a substitute for human analysis and decision-making in formative assessments.

Teachers raise concerns about plagiarism, cheating, and the authenticity of research when using AI tools. This indicates that if AI is used to write or create the content, it might lead to ethical issues. they emphasize that AI should be used without copying content directly, and some also mention that using AI is like people using a tool to cheat. This caution highlights the necessity when implementing AI tools for purposes of formative assessment for clear and formal instruction about usage-rich guidelines and ethics training on both sides (teachers and students) about their right use. Ensuring the authenticity of students' work becomes vital to maintaining the integrity of assessments.

There was also a contrasting view, asserting that ethical considerations do not inherently conflict with AI use in research. This teacher believes that a credible researcher can leverage AI tools to enhance their performance without compromising the quality and integrity of their work. This perspective implies that ethical boundaries might be breached when using AI in formative assessment but only if used in a responsible way. Therefore, we need to train teachers in responsible and trustworthy AI and emphasize that it is there to complement their work, not to replace them.

The findings suggest that teachers recognize major ethical issues about utilizing AI research and formative assessments in practice including privacy concerns, the risk of plagiarism, and the potential impact on researchers' critical thinking. Most participants seem wary of relying too heavily on AI, suggesting that there is a perceived risk of undermining personal effort, originality, and ethical research practices. Nevertheless, it is also given attention that artificial intelligence can be used responsibly with adequate best practices and policies.

This highlights a critical implication for incorporating AI into formative assessment: the importance of establishing practical ethical frameworks, data privacy protocols, and

educational preparation for educators. These measures may better address the ethical concerns in order to enable more responsible and effective integration of AI into formative assessment (RQ4).

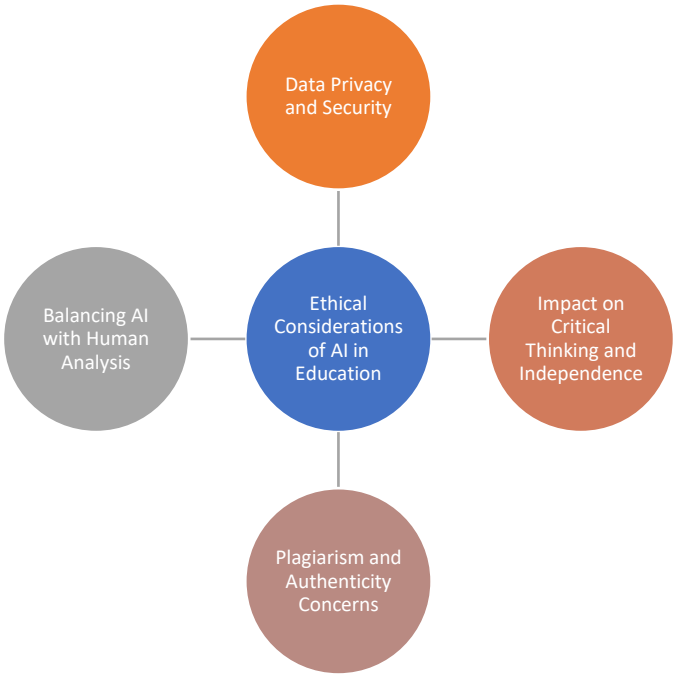


Fig. 2. Ethical Concerns of Teachers on Using AI in Research and Formative Assessment

Discussion

The results of this study highlight the promising potential of AI-supported formative assessments in fostering a student-centered learning environment. The data analysis confirms that the data gathered accurately measured desired properties for AI in formative assessment. This internal validity enhances the credibility of the study's claims about AI being useful in educational contexts [19]-[21].

The data analysis also demonstrates positive general sentiment about AI tools among educators but hesitance to discover coherence in some responses. This variance presents quite various perspectives from teachers, which are mostly due to their AI understanding or their localizations. Together, the absence of major differences found across public, private, and UNRWA teachers strengthens the outcomes arguing that factors other than school type are at play in predicting teacher attitudes toward AI. It reiterates that AI tools for formative assessments use are useful in educational practice in general.

Teachers' responses reveal that AI tools are viewed positively for their potential to revolutionize traditional assessment methods. Key benefits noted include the efficiency of data collection and analysis, which aligns with the observed mean score. AI's ability to streamline assessment processes, generate creative ideas, and handle complex data sets could

significantly enhance formative assessments (see also Table 1). These benefits help establish a learning environment where students are at the center, and timely feedback and multiple assessment activities support varied student needs. These results align with prior studies that have emphasized these advantages in assessment [2],[9].

Table 1. Examples of AI tools currently used in education for formative assessment

AI Tool	Features	Educational Applications
ChatGPT	Natural language processing, text generation	Provides real-time feedback on student responses, assists in writing development
Grammarly	AI-powered grammar and style checking	Offers formative feedback on writing assignments, helping students refine their work
Carnegie Learning's MATHia	Adaptive learning, personalized pathways	Assesses student progress in mathematics and adapts content accordingly
Socrative	Real-time student response system	Enables formative assessment through quizzes and instant feedback
DreamBox Learning	AI-driven adaptive learning in math	Provides personalized learning experiences based on student performance
Century Tech	AI-powered personalized learning	Uses cognitive neuroscience to adapt learning materials for students
Knewton Alta	Adaptive learning for STEM subjects	Adjusts difficulty level based on student comprehension
Edmentum Exact Path	Data-driven personalized learning	Tracks student performance and adjusts assessments accordingly
Intelligent Tutor Systems (ITS)	AI-driven tutoring	Provides step-by-step problem-solving assistance in various subjects

However, concerns regarding AI's ethical implications cannot be overlooked. Concerns teachers expressed related to data privacy, intellectual property, and the possible negative consequences of critical thinking skills. With AI, that worry is even more pressing because AI solution requires vast data sets, some of which may be sensitive [5],[16],[17]. This speaks to the importance of robust data protection policies and ethical guidelines. Another important aspect to consider is the potential for AI intuition to overshadow personal effort and critical analysis. While AI can provide valuable insights, it should complement rather than replace human judgment and engagement.

In addition, the dangers of plagiarism and authenticity issues with AI use mean that both educators and students require guidelines to be established as well as ethical training. This wariness of AI misuse among educators underscores the need for academic integrity and that AI tools are used ethically and responsibly.

Despite these concerns, the evidence suggests that when implemented thoughtfully, AI-supported formative assessments can lead to tangible academic improvements. For example, Zawacki-Richter et al. [8] conducted a meta-analysis of AI in education and found that automated feedback systems consistently improved learning efficiency, particularly in large classrooms where individualized teacher feedback is challenging. Similarly, Hwang et al. [22]

reported that AI-based formative assessments in language learning enhanced students' writing skills through iterative, data-driven feedback loops. Another study demonstrated the impact of AI-integrated instruction on students' reading comprehension, academic enjoyment, personal best goals, and academic mindfulness [23]. Utilizing Nearpod, an AI-driven platform, the experimental group demonstrated significant improvements across all measured areas compared to the control group. The interactive features of Nearpod facilitated increased student engagement and motivation, contributing to these positive outcomes. Moreover, Ji et al. [24] explored the role of AI-driven performance assessment in blended learning environments and its influence on students' motivation for continuous learning. Their study revealed that AI assessments contributed to higher levels of expectation confirmation, perceived usefulness, and learning satisfaction. While no direct impact on continuous learning intention was identified, the findings suggest that AI assessments may indirectly support sustained learning motivation by enhancing these key factors.

Conclusion

In summary, while AI and formative assessments offer substantial benefits in terms of efficiency, creativity, and data analysis, their integration into educational practices must be managed carefully. It is vital to establish ethical standards and education programs to address issues concerning data privacy, academic integrity, and the danger of negative influence on critical thinking. With these measures in place, AI has great potential to aid in achieving a more student-centered approach to learning and improve both assessment practices and the phenomenon of education in general.

Limitation and Suggestions

This study has several recommendations for several aspects of the community after the findings of the study. First, the study recommends that educational institutions should collaborate with policymakers and AI experts to create clear, ethical guidelines for AI use in formative assessments. These guidelines should address concerns about data privacy, intellectual property, and academic integrity, ensuring that AI is used responsibly in educational settings. Secondly, educators should be provided with regular professional development and training on AI tools and their application in formative assessments. This training should focus on building teachers' AI literacy and addressing local challenges in different educational environments. Thirdly, AI tools should be used as a supplement to human decision-making in teaching and assessment practices, but not as a replacement. Fourthly, the study recommends that teachers and educational researchers continuously monitor the impact of AI on students' critical thinking skills, ensuring that AI complements critical thinking rather than diminishes it. Finally, the study recommends that research on the long-term effects of AI-

supported formative assessments should be conducted particularly on how they impact student learning outcomes and teacher practices across diverse educational contexts.

Conflict of Interest

The author declared that there is no conflict of interest.

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