AI-driven Feedback and Its Impact on Student Motivation in Online Learning

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Abstract

The rise of Artificial Intelligence (AI) in online learning has reshaped education, with AI-driven feedback as a key innovation. This paper systematically reviews its role in enhancing student motivation through the lens of Self-Determination Theory (SDT). Using a PRISMA-based Systematic Literature Review (SLR), 20 journal articles were selected from Scopus and Web of Science. VOSviewer supported bibliometric and thematic analyses, mapping keyword co-occurrence and research trends. Results show that AI-driven feedback enhances competence through timely, specific guidance; promotes autonomy through adaptive personalization; and fosters relatedness through interactive features and gamification. Challenges include affective satisfaction, ethical concerns, data privacy, and balancing teacher technology roles. AI-driven feedback can enhance intrinsic motivation in online learning when integrated with sound pedagogy and teacher support. Future research should explore long-term impacts and refine strategies for human AI balance.
Keywords: AI-driven feedback, adaptive learning, student motivation, online learning

Abstrak

Munculnya Kecerdasan Buatan (AI) dalam pembelajaran online telah membentuk kembali pendidikan, dengan umpan balik berbasis AI sebagai inovasi utama. Makalah ini secara sistematis meninjau perannya dalam meningkatkan motivasi siswa melalui lensa Teori Penentuan Nasib Sendiri (SDT). Dengan menggunakan Systematic Literature Review (SLR) berbasis PRISMA, dipilih 20 artikel jurnal dari Scopus dan Web of Science. VOSviewer mendukung analisis bibliometrik dan tematik, memetakan kemunculan bersama kata kunci dan tren penelitian. Hasil menunjukkan bahwa umpan balik berbasis AI meningkatkan kompetensi melalui panduan spesifik yang tepat waktu; mempromosikan otonomi melalui personalisasi adaptif; dan menumbuhkan keterkaitan melalui fitur interaktif dan gamifikasi. Tantangannya termasuk kepuasan afektif, masalah etika, privasi data, dan menyeimbangkan peran teknologi guru. Umpan balik berbasis AI dapat meningkatkan motivasi intrinsik dalam pembelajaran online bila diintegrasikan dengan pedagogi yang baik dan dukungan guru. Penelitian di masa depan harus mengeksplorasi dampak jangka panjang dan menyempurnakan strategi untuk keseimbangan AI manusia.
Kata kunci: umpan balik berbasis AI, pembelajaran adaptif, motivasi siswa, pembelajaran online

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INTRODUCTION

The development of digital technology has brought significant changes to education, particularly with the rise of Artificial Intelligence (AI), which plays an important role in supporting online learning. One of the most prominent forms of AI application is the ability to provide feedback (Feedback) automatically, quickly, and adaptively to students (Alenezi, 2023). In the context of asynchronous online learning, AI can overcome the limitations of face-to-face interaction by providing a system that monitors, evaluates, and adjusts materials to individual needs (Salameh, 2025). This is highly relevant for maintaining students' learning motivation, particularly in the areas of competence, autonomy, and social connectedness, which form the foundation of Self-Determination Theory (SDT). The integration of AI into online learning offers a significant opportunity to improve educational quality while delivering a more personalized learning experience (Howard et al., 2021).

Numerous prior studies have demonstrated the potential of artificial intelligence (AI) to enhance the effectiveness of online learning. (Lee et al., 2021) revealed that adaptive technology that utilizes algorithms can increase knowledge retention and provide challenges according to students' ability levels. However, Zawacki-Richter et al. (2019) highlight challenges such as digital divides, algorithmic biases, and variations in effectiveness across learning contexts. More recent findings have Salameh (2025) affirmed that AI-based real-time feedback systems can encourage engagement and motivation to learn, while still facing ethical and accessibility issues. In line with this Wang et al (2024), a systematic literature review found that applications of AI in education include adaptive learning, intelligent tutoring, and assessment systems. Yet, there remains a lack of critical reflection on the risks and on pedagogical approaches. On the other hand Jegede, (2024) , it proves that AI-driven tools can improve personalization and instant feedback in language learning, while Luo (2023) showing that AI-based adaptive platforms in China contribute to improved academic performance and student motivation.

Although the literature has discussed the role of AI in improving learning quality, research remains limited on its impact on students' psychological aspects, particularly motivation in asynchronous online learning. Most studies still focus on the effectiveness of AI in cognitive aspects, such as improving material understanding and learning outcomes. In contrast, motivational elements, including competence, autonomy, and social connectedness, have not been systematically explored. In addition, previous research has tended to rely on limited case studies or experiments; therefore, a Systematic Literature Review (SLR) is needed to provide a more thorough synthesis of how AI-based feedback can affect students' learning motivation across various online learning contexts.

The urgency of this research stems from the growing demand for online education, particularly following global changes during the COVID-19 pandemic, which have expanded the use of online learning platforms. In this context, student learning motivation is a key factor in determining the success of the learning process. With AI that provides real-time feedback, the opportunity to strengthen student motivation in accordance with SDT principles is even greater. However, without a deep understanding of how AI affects students' psychological well-being, its use may be suboptimal or even counterproductive.

This study aims to systematically examine the existing literature on the influence of AI-driven feedback on students' learning motivation in online learning platforms, particularly with respect to competence, autonomy, and social connectedness. This research is expected to provide a comprehensive understanding of the role of AI in

supporting learning motivation and to produce recommendations for developing more effective online education practices centered on students' psychological needs.

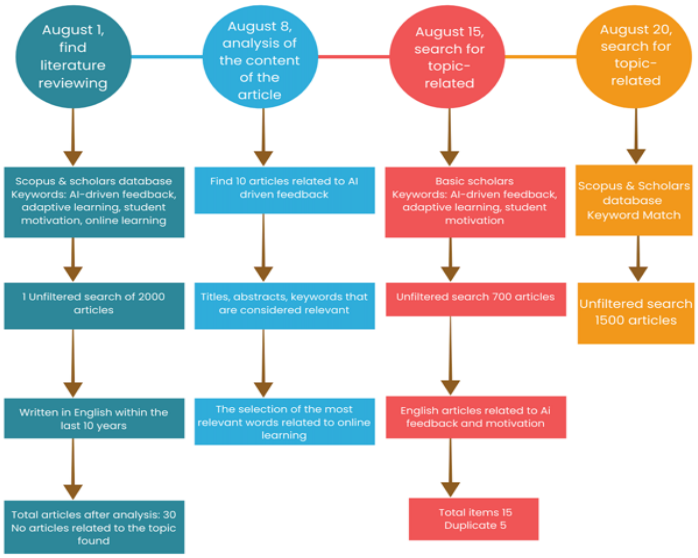
METHOD

The population of this study is scientific articles that discuss the use of AI-driven feedback and its impact on students' learning motivation in online learning platforms. The selected articles are sourced from international scientific databases such as Scopus and the Web of Science (WoS), which are considered the most relevant and up-to-date in the field of education and technology. Google Scholar is excluded due to limited quality control over indexed documents. The sampling technique employs a Systematic Literature Review (SLR) using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method. The search was conducted with the following keywords: *AI-driven feedback*, *adaptive learning*, *student motivation*, *online learning*, and *self-determination theory*.

The research instrument is *a* Systematic Literature Review protocol that specifies criteria for article inclusion and exclusion. The article is included when: 1) discussing the use of AI in providing feedback, 2) focusing on the context of online learning, and 3) examining students' learning motivation, either directly or using motivational theory frameworks such as Self-Determination Theory (SDT). Articles that do not meet these criteria, are not based on scientific research, or are not in English are excluded. The validity of the research protocol is ensured by adherence to the PRISMA flow diagram standard. At the same time, reliability is strengthened by a consistency test among researchers during the article selection process.

The research process was carried out through five stages: 1) formulating the main research question, namely "What is the impact of AI-based feedback on student motivation in online learning platforms?"; 2) establish inclusion and exclusion criteria; 3) search articles in databases (Scopus and WoS) using a combination of keywords; 4) screening, grouping, and documenting articles as they are relevant; and 5) synthesize findings. The literature search was conducted from 2010 to 2025 to capture the latest developments in AI for online education.

Graph 1.
Library Review Flowchart

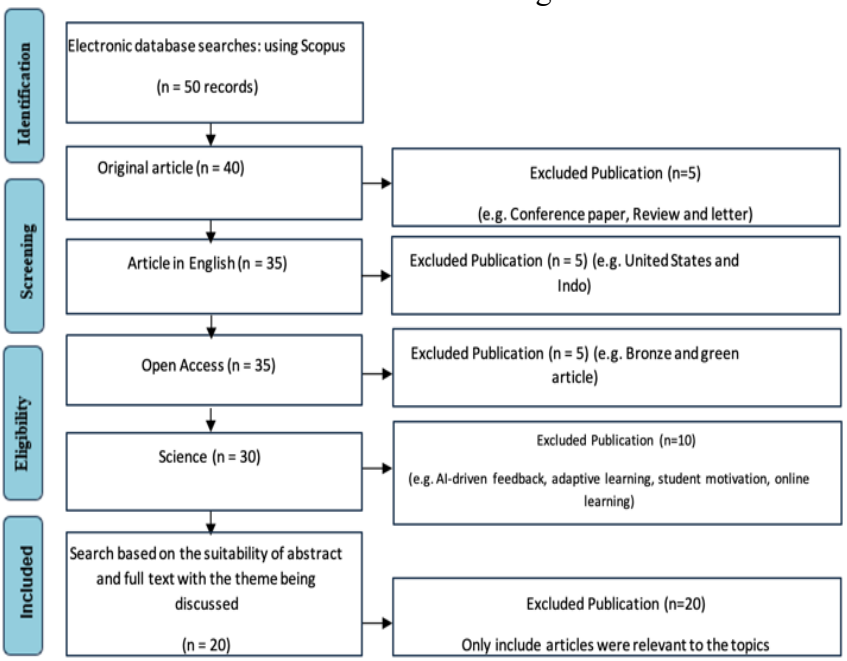


Articles that passed the selection stage were analyzed descriptively and thematically. The analysis was conducted by grouping the research results into three dimensions of motivation according to Self-Determination Theory: competence, autonomy, and relatedness. In addition, a simple bibliometric analysis was conducted to examine publication trends, and a comparative analysis of results across studies was undertaken to identify similarities, differences, and research gaps.

The scope of this study is limited to articles published in English and indexed in internationally reputable databases (Scopus and WoS). The main limitation is the risk of missing relevant articles published in national journals or in other databases, such as Google Scholar. In addition, SLR results depend on the quality of the available articles; therefore, the generalization of research findings must be conducted carefully.

From the initial search results, which yielded thousands of articles, a gradual selection process was carried out using the PRISMA framework, beginning with language filtering, publication time range, and content relevance checks. In the content analysis stage, 10 primary articles on AI-driven feedback were identified; a follow-up search then yielded 10 additional relevant articles after removing duplicates. Thus, the final analysis included 20 articles deemed most appropriate to the study's focus.

Graph 2.
Article selection used in SLR using PRISMA



RESULT AND DISCUSSION

Results

This study aims to systematically examine the existing literature on the influence of AI-driven feedback on students' learning motivation in online learning platforms, particularly with respect to competence, autonomy, and social connectedness. Direct sources of knowledge in the period 2010-2025. In this study, the researcher used VOSviewer to analyze the data, focusing on two data sources: text and bibliographic data. VOSviewer is a software for building and visualizing bibliometric networks. This network can, for example, include individual journals, researchers, or publications and can be constructed from citations, bibliographic coupling, co-citations, or co-authorship relationships. The results of the analysis can be seen in the explanation below:

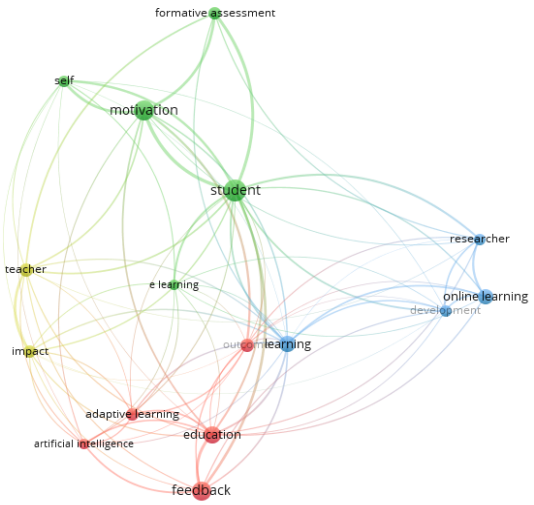


Figure 3. Correlation Between the Title and Abstract of The Articles

Figure 3 shows the results of a co-occurrence analysis using VOSviewer, in which the keywords appearing in the article title and abstract are interconnected to form several clusters. The word "student" is central, with strong connections to terms such as motivation, feedback, education, and online learning. The green cluster focuses on the themes of motivation, self, and formative assessment; the red cluster highlights the roles of feedback, adaptive learning, and artificial intelligence; while the blue cluster emphasizes online learning, researchers, and development. This inter-cluster relationship indicates that research on student learning motivation is closely associated with the use of AI-driven feedback and adaptive learning approaches in online learning contexts.

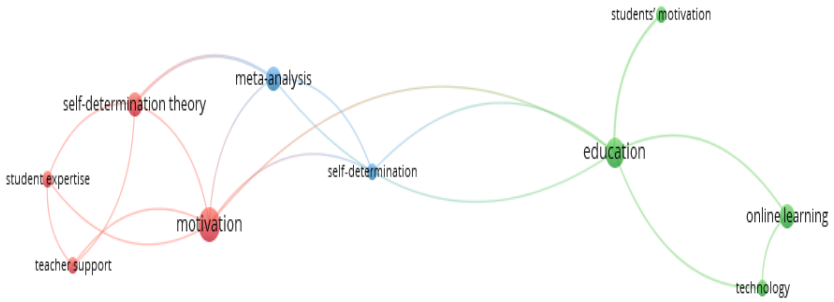


Figure 4. Keyword analysis

The results of the keyword analysis are processed using VOSviewer in figure 4. The above shows the existence of three main clusters that are interconnected. The red cluster highlights the concept of motivation, which is closely related to self-determination theory, teacher support, and student expertise, underscoring the importance of these factors in fostering learning motivation. The blue cluster emphasizes meta-analysis and self-determination, which serve as theoretical bridges linking motivation to educational contexts. Meanwhile, the green cluster focuses on education, which is closely related to students' motivation, online learning, and technology, showing that technological developments and online learning have an important role in increasing student motivation. Overall, this map confirms that educational motivation is influenced by psychological theory, learning environment support, and technological developments.

This research analyzes 20 journal articles published between 2018 and 2025, focusing on AI-driven feedback and its impact on student motivation in online learning platforms. The analysis was conducted using Publish or Perish 8, retrieving data from Google Scholar and from Scopus-indexed journals (Q1-Q4). The keywords used include AI-driven feedback, adaptive learning, student motivation, and online learning. The selected studies were reviewed and synthesized to identify patterns, strategies, and the role of AI-based feedback in enhancing student engagement and motivation in digital learning environments. The overview of selected articles is summarized in Table 1.

Table 1.
Articles AI-driven Feedback, Adaptive Learning, Student Motivation, Online Learning

No	Writer(s)	Title and Year	Types of Research	Results
1	(Jacobsen & Weber, 2025)	The Promises and Pitfalls of Large Language Models as Feedback Providers: A Study of Prompt Engineering and the Quality of AI-Driven Feedback	Experiments / Comparative Studies	This study shows that the quality of AI-driven feedback is highly dependent on the quality of prompts. ChatGPT-4 generates better feedback than students (novices) and, in the categories of explanations, questions, and specificity, even surpasses expert feedback. This confirms the importance of prompt design to maximize the potential of LLMs in education.
2	(Xu et al., 2025)	Investigating Student Engagement with AI-Driven Feedback in Translation Revision: A Mixed-Methods Study	Mixed-Methods	Graduate students show high cognitive engagement in revising translations with AI feedback. Despite understanding feedback, affective satisfaction is only moderate. Behaviorally, actions are influenced by cognitive and affective factors, but there are inconsistencies. This study uncovers the complex dynamics of student engagement with AI feedback.
3	(Engeness & Gamlem, 2025)	Exploring AI-Driven Feedback as a Cultural Tool: A Cultural-Historical Perspective on Design of AI Environments to Support Students' Writing Process	Qualitative (Theoretical/Conceptual Studies)	Using the perspective of cultural-historical theory, this study shows that AI-driven feedback can be a cultural tool that strengthens the Assessment for Learning (AfL) process. AI systems designed with pedagogical principles in mind support the development of students' writing skills and independent learning.

4	(Adanyin, 2023)	AI-Driven Feedback Loops in Digital Technologies: Psychological Impacts on User Behavior and Well-Being	Qualitative / Conceptual Studies	Digital feedback loops increase motivation and social connectedness through features such as streaks & badges, but also pose a risk of technostress, addiction, and loss of autonomy. The study emphasizes the need to limit the use and design of healthier feedback mechanisms to support user well-being.
5	(Pishtari et al., 2023)	Evaluating the Impact and Usability of an AI-Driven Feedback System for Learning Design	Experiments (N=38)	An experimental study (N=38) found that teachers who used an AI feedback system produced better learning designs than the control group. Teachers consider the system to be quite easy to use, but there are doubts regarding trust in AI and its impact on the school community.
6	(Martin et al., 2020)	Systematic Review of Adaptive Learning Research Designs, Context, Strategies, and Technologies from 2009 to 2018	Systematic Review	A review of 61 articles found that the trend of adaptive learning publications peaked in 2015, mostly in Taiwan and the US, especially in the field of computer science. The main focus is on design & evaluation, learning style-based adaptation strategies, and adaptive feedback & navigation. The study highlights the research gap for the future.
7	(Gligorea et al., 2023)	Adaptive Learning Using Artificial Intelligence in e-Learning: A Literature Review	Literature Review	A review of 63 articles shows AI/ML plays an important role in personalizing learning. Adaptive algorithms improve engagement, retention, and learning outcomes; Some studies report an increase in test scores. Implementation-

				related challenges were also identified.
8	(Wang et al., 2023)	When Adaptive Learning is Effective Learning: Comparison of an Adaptive Learning System to Teacher-Led Instruction	Eksperimen / Quasi-Experimental	The study compared the Squirrel AI adaptive learning system with large classroom & small group teaching in China. Grade 8 students who used adaptive learning showed a higher increase in math test scores than the control group.
9	(Li et al., 2021)	Progress, Challenges and Countermeasures of Adaptive Learning: A Systematic Review	Systematic Review	The systematic review identified adaptive learning challenges, including limitations of cognitive comprehension, affective model bottlenecks, education-technology gaps, and data security and privacy issues. The solutions offered include new modeling based on cognitive principles, ZPD, and code chain technology.
10	(Soltani & Izquierdo, 2019)	Adaptive Learning under Expected and Unexpected Uncertainty	Theoretical/Conceptual	This article explains that the adaptive learning process is strongly influenced by two forms of uncertainty: expected uncertainty and unexpected uncertainty due to real changes in the environment. The authors emphasize the importance of understanding the interaction between the two at the computational and neural levels to explain how mammalian brains adapt to dynamic environments, as well as optimize decision-making and adaptive learning.
11	(Howard et al., 2021)	Student Motivation and Associated Outcomes: A Meta-Analysis	Meta-Analysis	Intrinsic motivation is closely related to the success and well-being of students. Identified regulation plays a big role

		from Self-Determination Theory (2021)		in persistence. Introjected regulation is related to performance goals but also ill-being. External regulation is not related to performance but decreases well-being. Amotivation related to bad results.
12	(Bureau et al., 2022)	Pathways to Student Motivation: A Meta-Analysis of Antecedents of Autonomous and Controlled Motivations (2022)	Meta-Analysis	Teacher autonomy support is more influential than parental autonomy support on need satisfaction. Competence is the strongest predictor of autonomous motivation, followed by autonomy and then relatedness.
13	(Kong, 2021)	The Role of Experiential Learning on Students' Motivation and Classroom Engagement (2021)	Experiments / Field Studies	Experiential learning (EL) increases motivation and classroom engagement by emphasizing a real learning experience. EL is aligned with a constructivist approach and is effective in increasing the value of education.
14	(Chiu et al., 2024)	Teacher Support and Student Motivation to Learn with Artificial Intelligence (AI) Based Chatbot (2024)	Survey / Quantitative	Intrinsic motivation with chatbots is influenced by teacher support and student expertise (self-regulated learning, digital literacy). Teacher support is more satisfying for the need for relatedness than autonomy.
15	(Leenknecht et al., 2021)	Formative Assessment as Practice: The Role of Students' Motivation (2021)	Qualitative / Survey	Formative assessment increases student autonomy, competence, and autonomy. Motivation is central to the reciprocal relationship between learning and formative assessment.
16	(Mayer, 2019)	Thirty Years of Research on Online Learning (2019)	Review	Online learning is effective when designed with research-based principles (cognitive load theory, multimedia learning). Emphasis on instructional

				methods, not media. Must identify the conditions for the limit of the effectiveness of instructional techniques.
17	(Ivan, 2020)	Advantages and Disadvantages of Online Learning (2020)	Review (Conceptual)	Online learning provides access flexibility, helps achieve goals, monitors student performance. However, it has limitations in the quality of interaction and access to technology.
18	(Dhawan, 2020)	Online Learning: A Panacea in the Time of COVID-19 Crisis (2020)	Review (SWOT Analysis)	The COVID-19 pandemic forced a shift to online learning. The article conducts a SWOT (Strengths, Weaknesses, Opportunities, Challenges) analysis of e-learning and highlights the role of EdTech startups.
19	(Castro & Tumibay, 2021)	A Literature Review: Efficacy of Online Learning Courses for Higher Education Institutions Using Meta-Analysis (2021)	Meta-Analysis / Literature Review	Meta-analysis shows online courses are effective if they are designed well with the ADDIE framework. Important factors: instructional design, institutional support, and program quality.
20	(Saqr et al., 2024)	Exploring the Acceptance and User Satisfaction of AI-Driven e-Learning Platforms (2024)	Survey / Quantitative	AI-based platforms (Blackboard, Moodle, Edmodo, Coursera, edX) have an effect on perceived usefulness & ease of use. Both affect satisfaction, but not directly on intention to use. Student self-efficacy moderates the intention of use.

Discussion

AI-driven feedback has a central role in increasing student learning motivation through strengthening a sense of competence. A study by Jacobsen & Weber (2025) confirms that the quality of prompts strongly determines the quality of feedback, with ChatGPT-4 even surpassing experts in the categories of explanations and questions. Such feedback helps students understand their mistakes and improve their learning strategies,

thereby reinforcing a sense of accomplishment. This is consistent with findings Wang et al (2023) that adaptive learning improves math test performance more than traditional teaching. Thus, AI-driven feedback not only serves as a correction, but also as a mechanism to build students' self-confidence in their abilities.

AI-based feedback also helps strengthen student autonomy in online learning. A study by Engeness & Gamlem (2025) shows that AI can function as a "cultural tool" that supports self-directed learning and the Assessment for Learning (AfL) process. With the right pedagogical design, students are given space to choose, reflect, and independently develop their learning strategies. This aligns with the findings of Martin et al (2020), which emphasize the importance of instructional design in adaptive learning, where adaptive feedback and navigation support students' autonomy in their learning process. In other words, AI-driven feedback can increase autonomy by giving students greater control over how they respond to and use it.

In addition to competence and autonomy, social connectedness is influenced by digital feedback mechanisms. Adanyin (2023) highlights that digital feedback loops, although often used in a technological context, increase motivation by building connectedness through features such as streaks and badges. Despite the risk of technostress, the resulting interaction can increase a sense of community in the online environment. In line with this, Field Pishtari et al (2023) we found that while teachers value AI feedback systems in learning design, they still have doubts about trust and its impact on the school community. This shows that social connectedness is not only built among students but also involves relationships among students, teachers, and technology.

Nevertheless, student engagement with AI feedback is not always linear. Xu et al (2025) report that graduate students exhibit high cognitive engagement with translation revision using AI feedback, but their affective satisfaction is only moderate. This means that while AI-driven feedback is effective at aiding understanding, it falls short in fostering deep emotional connections. This is reinforced by Li et al (2021)those who highlight the challenges of adaptive learning, particularly the limitations of affective experience and the gap between technology and human needs. Thus, to increase motivation, AI systems should consider affective aspects in feedback design so that students not only feel capable but also emotionally connected.

The survey results in Indonesia also confirm an imbalance between cognitive engagement and affective satisfaction in the use of AI-based feedback. Research Rofikah et al (2025) involving 100 EFL students in Makassar found that the majority of respondents felt that AI helped improve the quality of writing, revision efficiency, and boost motivation and confidence. However, some respondents reported frustration when AI was unable to understand local context or academic writing style, resulting in emotional experiences of AI use that were not always positive. These findings show that cognitive improvement is not automatically aligned with students' affective satisfaction; rather, it depends on the AI system's sensitivity to users' context.

Another study Ningsih et al (2024) involving 252 students at several universities found that positive perceptions of AI were significantly correlated with motivation, satisfaction, and perceived benefits. However, affective aspects such as comfort and emotional satisfaction are not always equivalent to the cognitive improvements obtained, for example, in writing skills. These results are consistent with an experiment that found that adding emotional elements to feedback can reduce negative emotions but does not significantly affect work quality or student engagement compared with neutral feedback. In addition, a study Mayordomo et al (2022) involving 191 college students also

confirmed that emotional perceptions of feedback strongly influence cognitive engagement: positive emotions encourage deeper processing, while negative emotions can actually inhibit such engagement.

From a psychological and cognitive perspective, AI-powered adaptive learning helps students adapt to uncertainty in the learning process (Soltani & Izquierdo, 2019). Explains that adaptive learning is influenced by expected and unexpected uncertainty. AI feedback can reduce this uncertainty by providing timely and relevant guidance, thereby increasing students' confidence in making learning decisions. Furthermore, Gligorea et al (2023) emphasize that adaptive algorithms can improve engagement, retention, and learning outcomes through personalization. This personality reinforces the student's sense of competence and autonomy, as they feel that the learning process aligns with their needs.

Students' acceptance of AI-driven feedback in online platforms is also related to intrinsic motivation. Saqr et al (2024) shows that perceived usefulness and ease of use affect student satisfaction, although not directly on intention to use. Moderating factors, such as self-efficacy, are key in determining the extent to which students are willing to use AI feedback in the learning process. This emphasizes that AI-driven feedback can drive motivation when combined with support for autonomy, competence, and social connectedness.

In addition, recent research confirms that AI-driven feedback on online learning platforms can increase student motivation through personalization and real-time engagement. Salameh (2025) shows that AI-based real-time feedback systems can adapt content to individual needs, thereby improving retention and learning motivation. In line with this, (Byers, 2024) found that AI-provided automated feedback can reinforce students' perceptions of competence. However, its effectiveness remains influenced by teacher communication, thereby confirming the importance of a blended approach between AI and humans. Furthermore, the teacher's perspective in the study Alenezi (2023) highlights that AI-driven gamification can improve engagement, motivation, and learning outcomes by providing instant feedback and a more enjoyable learning experience. Meanwhile, Jegede (2024) 80% of students reported that instant AI feedback accelerates language acquisition and improves learning satisfaction. These results are reinforced by Saqr et al (2024) which emphasizes that the perceived usefulness and ease of use of AI-driven platforms have a significant influence on student satisfaction, which ultimately impacts their motivation in the online learning environment.

Previous research has shown that the effectiveness of AI-based feedback varies with educational level and student characteristics. For example, a study by Dai et al (2025) on high school students found that the low-achieving group experienced a significant improvement in physics achievement when receiving heuristic solution hints from AI (effect size $d = 0.673$; $p < 0.05$). In contrast, students with moderate achievement showed a decrease in scores when using conventional answers, whereas high-achieving students showed a mild improvement when given full control over feedback choices. These findings confirm that students' academic backgrounds and learning readiness levels are important determinants of their responses to automated feedback. Education at the secondary, tertiary, and professional levels must be considered to ensure that the application of AI in learning is truly relevant to students' needs.

Quantitative evidence further supports the conclusion that AI-based feedback contributes to improved measurable learning outcomes. Escalante et al., (2023), an analysis of 12,100 essays by non-native college students found that ChatGPT feedback is

highly compatible with instructor feedback, particularly in organizational aspects of writing and grammar. This indicates that AI can not only complement, but also reinforce the quality of traditional evaluations. Combined with quantitative data from Dai et al (2025) the secondary school level, it is seen that the use of AI feedback can result in improved academic achievement with significant effect measures, ranging from d = 0.378 to d = 0.673, depending on the category of students.

In addition to the experimental results, the survey data provides a further picture of how AI feedback and AI tools are perceived and used by students in practice. For example, a survey Freeman (2025) involving 1,041 undergraduate students showed that 88% of respondents are now using generative AI in their assessments, up from 53% the previous year, and 92% report using AI tools in any form. Furthermore, a survey (Kelly, 2024) that collected nearly 3,839 college students from 16 countries found that 86% of college students already use AI in their studies, with 24% of them using AI every day. These data indicate that the use of AI is no longer a marginal phenomenon, but has become a significant part of many students' study routines.

The findings of this study provide important implications for the development of online learning designs that integrate AI-driven feedback. First, AI-based real-time feedback systems have been proven to increase student learning motivation through strengthening competence, autonomy, and social connectedness. This suggests that e-learning platform developers need to design algorithms that not only provide answer correction but also present personalized, adaptive feedback oriented toward psychological support. AI not only serves as a technical tool but also as a pedagogical partner that facilitates meaningful learning in accordance with individual needs.

Second, the study's results confirm the importance of a blended approach combining AI and human intervention. Although AI can provide instant feedback and increase student engagement, its full effectiveness is achieved only when combined with teacher communication and affective support. Therefore, educational institutions need to develop an AI integration strategy that balances the roles of technology and humans, including teacher training to optimize the use of AI feedback. In addition, education policies must consider accessibility, ethics, and student readiness to ensure that the implementation of AI-driven feedback is inclusive and sustainable in increasing student motivation and learning outcomes in the online environment.

While the findings of this study demonstrate the significant potential of AI-driven feedback to improve student motivation, engagement, and satisfaction, some limitations warrant note. First, most of the studies analyzed (Byers, 2024; Jegede, 2024; Saqr et al., 2024) still employ short-term or survey-based research designs, and thus cannot yet describe the long-term impact of AI-driven feedback on intrinsic motivation and sustainable learning outcomes. Second, limitations related to context and sample also emerge, such as studies with relatively small numbers of participants (Byers, 2024) or those that focus on specific educational contexts, thereby limiting generalizations to the broader population. In addition, affective aspects such as emotional satisfaction and interpersonal relationships, which are involved in the use of AI feedback (Xu et al., 2025; Li et al., 2021), have not been explored in depth.

For further research, a longitudinal study is recommended to evaluate the long-term impact of AI-driven feedback on motivation, retention, and learning outcomes. Research across educational contexts (e.g., high school, university, and professional learning) also needs to be conducted to understand the variation in acceptance and effectiveness of AI-driven feedback. Furthermore, the integration of mixed methods

between quantitative and qualitative approaches will provide a more comprehensive understanding of how students respond to AI feedback, both from cognitive and affective aspects.

CONCLUSION

AI-driven feedback has an important role in increasing students' learning motivation on online learning platforms through strengthening competence, autonomy, and social connectedness. Studies have shown that adaptive and real-time feedback can help students understand their mistakes, adjust their learning strategies, and increase their confidence. In addition, AI-based personalization and gamification have been shown to encourage engagement and satisfaction with learning. However, challenges remain regarding affective dimensions and educators' roles in maintaining a balance between technology and human interaction. AI-driven feedback can be an effective instrument in supporting students' intrinsic motivation when integrated with appropriate pedagogical design and active collaboration between technology and teachers. Based on the study's findings, it is recommended that educators use AI-driven feedback to support the learning process, rather than as a substitute for teachers, so that students' cognitive and affective aspects are maintained in a balanced manner. Developers of online learning platforms also need to design systems that provide adaptive, personalized, and meaningful feedback while maintaining interactive elements that encourage student engagement.

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