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Development of Automatic Assessment System Based on Machine Learning for Student Learning Evaluation

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ABSTRACT
The rapid advancement of machine learning (ML) has significantly impacted educational technologies, particularly in the area of student assessment. Traditional assessment methods often require substantial time and resources, and may not provide immediate or personalized feedback. An automatic assessment system based on machine learning can offer an efficient solution by automating the evaluation process and providing real-time, data-driven insights into student performance. This study explores the development of an automatic assessment system using machine learning algorithms to evaluate student learning and provide personalized feedback in real-time. A mixed-methods approach was used in this research, combining the design and development of the system with quantitative analysis of its effectiveness. The system was tested on 300 students across different academic disciplines, and data was collected from their interactions with the assessment system. Machine learning algorithms, including natural language processing and classification models, were employed to analyze student responses and generate feedback. The results indicate that the machine learning-based system significantly improved the speed and accuracy of student assessments, providing personalized feedback that helped students identify areas for improvement. The system also reduced the administrative burden on educators. This study concludes that machine learning-based automatic assessment systems are a valuable tool for enhancing the learning evaluation process, offering immediate, scalable, and personalized feedback to students.

Keywords: *Automatic Assessment, Educational Technology, Personalized Feedback*

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INTRODUCTION

In recent years, the field of education has witnessed a significant transformation with the increasing integration of technology, particularly in the areas of assessment and learning evaluation (Silva dkk., 2025; Tojima & Yoshida, 2025). Traditional methods of student assessment, such as manual grading, examinations, and feedback, often present challenges related to time constraints, accuracy, and personalization. These conventional approaches can also be inefficient for large classrooms or in settings where immediate feedback is required. Machine learning (ML) offers promising solutions to these

challenges by automating the assessment process, providing real-time evaluation, and delivering personalized feedback based on student responses (Wang dkk., 2025; Zhang dkk., 2025). As educational institutions continue to evolve, incorporating AI and machine learning-based systems into the assessment process has the potential to revolutionize how learning outcomes are evaluated (Wang dkk., 2025; Zhang dkk., 2025). The development of automatic assessment systems that leverage machine learning algorithms can make assessments more efficient, scalable, and personalized, addressing many of the limitations of traditional methods.

Despite the potential benefits of automated assessment systems, there are significant challenges in their development and implementation (Kamal dkk., 2025; Nakamoto dkk., 2025). One key issue is the ability of machine learning algorithms to accurately analyze and assess student responses, particularly when dealing with complex, open-ended answers that require subjective judgment. Additionally, many existing automated systems primarily focus on specific subjects or question types, limiting their scope and flexibility. There is also a gap in understanding how these systems can provide personalized feedback that is meaningful and relevant to each student's individual learning journey. Educators and students need systems that not only automate assessments but also adapt to the unique learning styles, strengths, and weaknesses of each student. This study addresses these challenges by developing an automatic assessment system based on machine learning that can evaluate a wide range of student responses, including both objective and subjective questions, while also delivering personalized feedback.

The main objective of this research is to design and implement an automatic assessment system powered by machine learning algorithms to evaluate student learning across multiple subjects and provide personalized feedback. The study aims to develop a system that can process both objective data (e.g., multiple-choice or true/false questions) and subjective data (e.g., essay-type questions) to generate comprehensive assessments of student performance (Kirsch dkk., 2025; Shin & Yang, 2025). Additionally, the system will incorporate natural language processing and classification models to ensure that the feedback provided is specific, actionable, and tailored to each student's needs. This research will also investigate how the machine learning system can be integrated into existing educational platforms to optimize the learning experience and assist educators in monitoring student progress more efficiently. The goal is to develop a scalable, accurate, and user-friendly system that can enhance the overall learning evaluation process and improve the quality of feedback provided to students.

A review of the literature reveals several gaps in current research regarding the development and application of machine learning in student assessments. While there has been significant progress in the development of automated grading systems, most existing research focuses on specific question formats, such as multiple-choice questions or simple essay evaluations (Dong dkk., 2025; Imani dkk., 2025). Furthermore, many existing systems rely on rule-based approaches or limited machine learning algorithms that are not capable of providing the level of sophistication needed for real-world educational settings. Most studies also lack a focus on personalization, as many automated systems are not

designed to adapt to individual student needs or provide meaningful, customized feedback. This research contributes to the existing body of knowledge by addressing the need for a comprehensive, machine learning-based assessment system capable of handling a variety of question types and offering personalized feedback based on the analysis of student responses (Imani dkk., 2025; Shi & Ma, 2025). The study's findings will expand the current understanding of how machine learning can be applied to enhance educational assessment practices in a way that is both efficient and effective.

This research is novel in its approach to integrating machine learning algorithms for the automatic evaluation of a wide range of student responses, including both objective and subjective answers. While previous studies have explored automated grading systems, few have focused on developing an AI-powered assessment tool that provides personalized, real-time feedback across various types of assessments and subjects. Additionally, this study emphasizes the scalability and adaptability of machine learning-based systems in diverse educational contexts (Gomroki dkk., 2025; Neti dkk., 2025; Ong & Høye, 2025). By incorporating advanced machine learning techniques, such as natural language processing and classification, the system developed in this study aims to improve both the accuracy and depth of student evaluations. The novelty of this research lies in its focus on enhancing not only the efficiency of the assessment process but also its ability to provide meaningful and individualized feedback that supports student learning and development. The results of this study will contribute significantly to the growing field of AI in education and provide practical insights for educators and institutions seeking to optimize the learning evaluation process through technology.

RESEARCH METHODOLOGY

This study utilizes a design-based research methodology to develop and evaluate an automatic assessment system based on machine learning (ML) for student learning evaluation. The research design incorporates both system development and empirical testing to assess the effectiveness and efficiency of the system in providing accurate, real-time student evaluations. The design is iterative, involving the development of an initial prototype, followed by testing, refinement, and implementation in real educational settings (Lin & Zuo, 2025; Zeng dkk., 2025). This methodology allows for continuous improvement of the system based on data collected from real-world usage, providing both technological insights and educational outcomes.

The population for this study consists of undergraduate students from three university departments (M. Liu dkk., 2025; Zuo dkk., 2025): Computer Science, Business Administration, and Education. A total of 300 students will participate in the study, with 100 students from each department. The sample will be selected based on their involvement in courses that include assessments of varying formats, such as multiple-choice, short-answer, and essay questions (Cascella dkk., 2025; Xiang dkk., 2025). These students will interact with the automatic assessment system over the course of one semester. The teachers responsible for these courses will also participate in the study, providing feedback on the system's usability, effectiveness in providing feedback, and its

integration into existing course structures. This sample size ensures a diverse set of students and learning contexts to test the system's applicability across different academic disciplines.

The instruments used in this study include the automatic assessment system itself, which is based on machine learning algorithms capable of analyzing student responses (C. Liu dkk., 2025; Xi dkk., 2025). The system will be integrated with the university's learning management platform, where it will automatically grade student submissions and provide feedback. To measure system performance, accuracy, and effectiveness, pre- and post-assessments of student learning outcomes will be conducted. Additionally, student engagement and satisfaction will be assessed through surveys and interviews, which will provide qualitative data on the students' experiences with the system (Kuruge dkk., 2025; Misztal & Hatlas-Sowinska, 2025). Feedback from instructors will also be gathered through structured interviews to evaluate how the system supports their grading and assessment tasks. This multi-faceted data collection approach will ensure that the system's impact on student learning and overall educational effectiveness is thoroughly evaluated.

The procedures for this study will unfold over the course of one academic semester. Initially, the automatic assessment system will be developed and integrated with the university's existing learning management platform (Blanch dkk., 2025; Zheng dkk., 2025). Teachers will receive training on how to use the system and incorporate it into their assessment practices. During the semester, students will take assessments that are automatically graded and evaluated by the system. At the beginning and end of the semester, pre- and post-assessment tests will be administered to measure any changes in student performance, particularly in areas related to knowledge retention, problem-solving, and critical thinking (De Rosa dkk., 2025; Misztal & Hatlas-Sowinska, 2025). Simultaneously, surveys and interviews will be conducted to collect data on students' and teachers' experiences with the system. The collected data will be analyzed using statistical methods to assess the accuracy, efficiency, and overall effectiveness of the system, while thematic analysis will be applied to the qualitative feedback to identify common themes and insights. The results will provide a comprehensive evaluation of the system's impact on student learning evaluation and its potential for integration into broader educational practices.

RESULTS AND DISCUSSION

The data collected in this study includes quantitative measures of student performance before and after interacting with the automatic assessment system, as well as feedback from students and instructors regarding their experiences with the system. The primary data for this study consists of pre- and post-assessment scores, which measure students' performance on assignments and exams graded by the system (Alkan & Taşdemir, 2025; Fissore dkk., 2025). Additionally, survey data was collected from 300 students across three academic disciplines, with a focus on student engagement and satisfaction. Table 1 below provides a summary of the key findings related to student performance and engagement.

Table 1: Summary of Pre-Test and Post-Test Results for Student Performance

Measurement	Pre-Test Average	Post-Test Average	Improvement (%)
Knowledge Retention	65.4	81.7	24.9%
Problem-Solving Skills	63.2	79.1	25.2%
Critical Thinking	64.0	80.5	25.8%
Student Engagement (Survey Score)	3.7	4.6	24.3%

The data shows significant improvements in all areas measured by the pre- and post-tests. The average improvement in knowledge retention was 24.9%, while problem-solving skills and critical thinking saw improvements of 25.2% and 25.8%, respectively. Additionally, student engagement, as measured by survey responses, increased by 24.3%. These results suggest that the automatic assessment system, which uses machine learning to grade and provide feedback on student submissions, had a positive impact on students' academic performance and overall engagement (Bhat & Strika, 2025; Zhao dkk., 2025). The increased engagement score indicates that students felt more involved in their learning process, likely due to the real-time feedback and personalized learning experience provided by the system.

Inferential analysis was conducted using paired sample t-tests to assess the statistical significance of the observed improvements in student performance and engagement. The t-test results revealed that the increase in knowledge retention ($t = 6.32$, $p < 0.001$), problem-solving skills ($t = 5.91$, $p < 0.001$), and critical thinking ($t = 6.50$, $p < 0.001$) were all statistically significant. This provides strong evidence that the machine learning-based assessment system contributed to these improvements. The t-test for student engagement also showed a significant increase ($t = 5.11$, $p < 0.001$), suggesting that the system's personalized approach to feedback and assessment had a meaningful effect on student involvement in their learning. These inferential findings confirm that the automatic assessment system has a significant and positive impact on student outcomes.

The relationship between student engagement and academic performance was further explored through correlation analysis. A strong positive correlation ($r = 0.82$, $p < 0.01$) was found between student engagement and improvements in problem-solving skills, indicating that the more engaged students were with the system, the greater their improvement in this area. Additionally, a moderate positive correlation ($r = 0.65$, $p < 0.01$) was found between engagement and knowledge retention. These results suggest that engagement with the system plays a crucial role in driving improvements in academic performance. The positive correlation further supports the hypothesis that real-time feedback and adaptive learning, facilitated by AI, contribute to increased student motivation and performance.

In a case study of a student from the experimental group, the use of the automatic assessment system led to significant improvements in both critical thinking and problem-solving abilities. Initially, the student struggled with complex problem-solving tasks, scoring 55 on the pre-test. After using the AI-powered system for four weeks, the

student's post-test score increased to 85, reflecting a 30-point improvement. The student reported that the immediate feedback and suggestions for improvement offered by the system helped them develop better strategies for tackling problems. This case exemplifies how AI can provide targeted support, helping students refine their thinking and problem-solving skills by giving them the opportunity to practice and receive real-time feedback.

This case study further illustrates the effectiveness of the machine learning-based automatic assessment system in providing personalized support to students. The system's ability to offer specific feedback on student responses and adapt to individual learning needs played a significant role in improving the student's performance. The feedback allowed the student to focus on areas of weakness, ultimately improving their problem-solving and critical thinking abilities. The case supports the broader findings of this study, which demonstrate that AI can not only assist in grading and evaluation but also serve as an educational tool to enhance student learning outcomes by fostering engagement and offering targeted feedback.

In summary, the results of this study demonstrate that the machine learning-based automatic assessment system significantly improves student academic performance and engagement. The inferential analysis confirms that the improvements in knowledge retention, problem-solving skills, and critical thinking were statistically significant, supporting the effectiveness of the system. The strong correlation between student engagement and academic performance underscores the importance of interactive and adaptive learning environments. The case study provides further evidence that the system's real-time feedback capabilities are crucial in helping students refine their skills. These findings suggest that machine learning-based assessment systems can play a transformative role in optimizing the learning evaluation process in educational settings.

The results of this study indicate that the development of an automatic assessment system based on machine learning (ML) significantly enhances the accuracy and efficiency of student learning evaluations. The system, which uses AI to grade both objective and subjective student responses, demonstrated a high level of accuracy, providing real-time feedback that helped students improve their understanding of the subject matter. The use of machine learning algorithms allowed for personalized feedback, identifying specific areas where students needed improvement. The post-assessment results showed an average increase of 24.9% in academic performance, with students demonstrating improved problem-solving skills, critical thinking, and knowledge retention. These findings suggest that an automatic assessment system can effectively support both educators and students by streamlining the assessment process and offering targeted feedback.

When comparing these findings with existing literature, they align with previous studies that highlight the benefits of AI in educational settings, particularly in the realm of assessment. Research by Heffernan & Heffernan (2014) and Koka & Spector (2019) emphasized that AI-based systems can improve learning outcomes by providing personalized learning experiences and real-time feedback. However, this study differs in its approach by incorporating a broader range of student responses, including subjective

tasks like essays, and applying machine learning algorithms to interpret and assess these responses. Previous studies have focused largely on automating objective assessments, such as multiple-choice questions, but have not extensively explored how machine learning can be applied to subjective evaluations. This research expands the use of AI tools in education, making it more inclusive and adaptable to different types of learning assessments.

The findings of this study reflect a shift towards more data-driven, personalized, and scalable approaches to student learning evaluation. The increase in student performance and engagement as a result of using the automatic assessment system is indicative of the growing need for adaptive, technology-driven assessment models in education. This suggests that traditional methods of assessment, while still valuable, are becoming less efficient in providing the level of personalized feedback and timely support that today's diverse student body requires. The study also signals that AI-based tools can assist teachers in managing large classes, freeing them from time-consuming grading tasks and allowing them to focus on providing more meaningful, individualized support to students. The results serve as an important signal that AI technologies have the potential to enhance teaching practices by optimizing the learning evaluation process.

The implications of these findings are significant for both educators and educational institutions. By implementing AI-based automatic assessment systems, schools and universities can reduce the administrative burden on teachers, increase the speed and accuracy of grading, and provide more timely, personalized feedback to students. The system's ability to offer real-time feedback can help students identify areas for improvement, thereby enhancing their learning outcomes. Additionally, educational institutions can utilize the data gathered from these systems to gain insights into overall class performance, track student progress more effectively, and identify areas where instructional strategies need to be adjusted. These implications suggest that AI-driven assessment systems can play a pivotal role in transforming how student learning is evaluated, ultimately leading to a more efficient and equitable educational experience.

The results are primarily driven by the ability of machine learning algorithms to provide personalized, adaptive feedback that responds to the specific needs of individual students. These algorithms can analyze large amounts of data from student interactions with assessments and identify patterns in learning behavior, allowing for more tailored interventions. The system's capacity to grade both objective and subjective responses also contributed to the improvement in student performance, as it provided a more holistic view of student understanding. Furthermore, the real-time feedback generated by the system encouraged students to engage more actively with the material, reinforcing concepts and helping them to better retain knowledge. The positive outcomes of this study highlight the potential for AI to support teachers in fostering more personalized, engaging, and effective learning experiences.

Moving forward, further research should examine the long-term effects of using automatic assessment systems on student performance and engagement. It will be important to assess whether the improvements observed in this study are sustained over

time and whether these AI-based systems can be scaled across different educational contexts. Additionally, future studies could explore how these systems can be integrated with other technologies, such as learning management systems and personalized learning platforms, to create even more comprehensive and adaptive learning environments. Research should also consider the impact of these systems on teacher roles, especially in terms of how AI tools can be leveraged to enhance instructional design and classroom management. By addressing these areas, future studies can further refine the implementation of AI-driven learning evaluation systems, ensuring their continued effectiveness and relevance in modern education.

CONCLUSION

The most significant finding of this research is the development of an automatic assessment system based on machine learning that can accurately evaluate both objective and subjective student responses. Unlike traditional automated grading systems that primarily assess multiple-choice or true/false questions, this system utilizes machine learning algorithms, including natural language processing, to evaluate essays and open-ended responses. The system provides real-time feedback on student submissions, allowing for personalized learning experiences that adapt to individual needs. This capability marks a significant advancement in educational assessment, as it offers a more comprehensive and nuanced evaluation of student performance compared to existing technologies.

This study contributes to the field by demonstrating how machine learning can be used not only for automated grading but also to improve the feedback process, making it more efficient and personalized. The use of natural language processing algorithms to analyze subjective student responses represents a novel approach to automated assessment, expanding the range of questions that can be assessed in real time. The research provides valuable insights into the potential of AI-driven assessment systems to support educators in providing personalized feedback at scale, saving time, and enhancing the quality of learning evaluations. By combining both objective and subjective assessments into a single automated system, this study offers a new method for enhancing the educational process.

One limitation of this study is the relatively narrow scope in terms of the types of assessments and subjects included. The automatic assessment system was tested primarily on English and social science subjects, with a limited number of student responses analyzed. This limits the generalizability of the results to other subjects or more complex assessments, such as those in STEM fields. Future research should expand the types of subjects and assessments included in the evaluation to determine how well the system performs across different academic disciplines. Additionally, the long-term impact of using AI-driven assessments on learning outcomes and student engagement remains unclear and warrants further investigation.

Future research should also explore the scalability of the automatic assessment system in diverse educational settings. Investigating how such a system can be integrated

into classrooms with varying levels of access to technology, including low-resource settings, would provide valuable insights into its broader applicability. Further studies could examine how the system can be adapted to different educational contexts, including varying educational levels and cultural contexts. Additionally, research should focus on the pedagogical implications of automated feedback systems, exploring how teachers can best use the data provided by AI tools to enhance their teaching strategies and provide more personalized learning experiences. These directions will help refine and expand the use of AI-based assessment systems in education, ensuring that these technologies benefit a wider range of students and educators.

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