BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg

DEVELOPMENT OF AN ARTIFICIAL INTELLIGENCE-BASED PEDAGOGICAL SYSTEM FOR MANAGING STUDENTS' INDEPENDENT LEARNING

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Doi: https://doi.org/10.5281/zenodo.21562344

Abstract: The rapid advancement of artificial intelligence (AI) has significantly transformed teaching and learning practices in higher education, creating new opportunities for managing students' independent learning. Despite the growing adoption of AI-powered educational tools, there remains a lack of comprehensive pedagogical systems that integrate AI into the planning, implementation, monitoring, and assessment of independent learning activities. This study aims to develop an artificial intelligence-based pedagogical system for managing students' independent learning that promotes learner autonomy, personalized instruction, continuous feedback, and effective learning management.

Keywords: Artificial Intelligence, independent learning, higher education, pedagogical system, self-regulated learning, learning analytics, adaptive learning.

Introduction. The rapid development of artificial intelligence (AI) is reshaping higher education and changing the way students learn, interact with knowledge, and complete academic tasks. In recent years, AI-powered technologies have become part of everyday educational practice, offering students immediate access to information, personalized learning support, and continuous feedback. As a result, universities are increasingly exploring how these technologies can be integrated into teaching and learning without compromising educational quality or students' intellectual development.

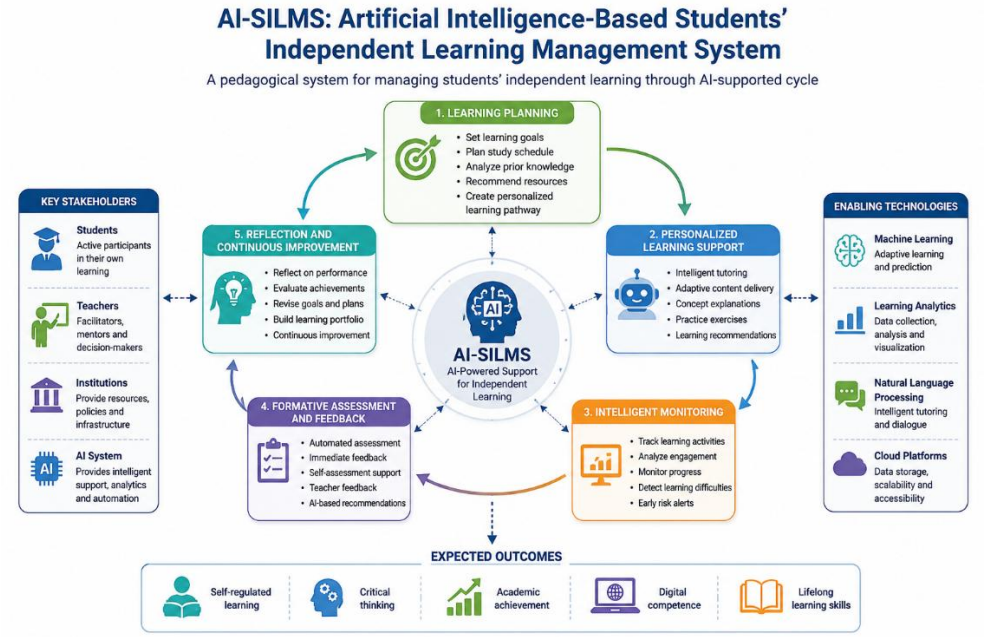
Independent learning has long been recognized as one of the fundamental components of higher education. It encourages students to take responsibility for their own learning by planning study activities, selecting appropriate learning resources, monitoring their progress, and reflecting on their achievements. These skills are particularly important in the twenty-first century, where graduates are expected to be lifelong learners capable of adapting to rapidly changing professional environments.

Recent advances in artificial intelligence offer new opportunities to address these challenges. Intelligent tutoring systems, learning analytics, adaptive learning platforms, and generative AI tools are capable of providing individualized recommendations, explaining difficult concepts, monitoring learning progress, and generating immediate feedback. When used appropriately, these technologies can help students become more self-regulated learners rather than simply making learning tasks easier. Current research also suggests that AI is most effective when it complements sound pedagogical design and supports students' autonomy instead of replacing their own cognitive effort.

Methodology. This study adopts a conceptual research design aimed at developing a pedagogical system for managing students' independent learning through artificial intelligence. Unlike empirical studies that focus on testing a particular AI application, the present research seeks to construct a theoretically grounded framework by synthesizing contemporary educational theories with recent advances in AI-supported learning.

Results. Existing research has demonstrated the educational potential of intelligent tutoring systems, adaptive learning environments, and learning analytics; however, these technologies are

often implemented independently rather than as parts of a coherent pedagogical system. The model consists of five interrelated components:



Stage 1. Learning Planning. Independent learning begins with effective planning. At this stage, AI assists students in organizing their study schedules, setting achievable learning goals, identifying prerequisite knowledge, and recommending relevant learning resources according to individual needs and academic performance. Personalized planning helps students develop realistic learning strategies while reducing uncertainty during independent study.

Stage 2. Personalized Learning Support. During the learning process, AI functions as an intelligent learning assistant. It explains complex concepts, recommends additional materials, generates practice exercises, and adapts learning content to the student's level of understanding. Rather than providing ready-made answers, the system encourages students to explore concepts, solve problems independently, and strengthen critical thinking skills.

Stage 3. Intelligent Monitoring. Continuous monitoring represents one of the most valuable contributions of AI to education. Learning analytics collect information about students' learning behavior, engagement, task completion, and progress toward learning objectives. Based on these data, the system identifies learning difficulties, predicts potential academic risks, and notifies both students and instructors when additional support may be required. Recent learning analytics frameworks emphasize this proactive use of educational data to improve student performance and guide timely interventions.

Stage 4. Formative Assessment and Feedback. Assessment is designed as a continuous learning process rather than a final measurement of achievement. AI provides immediate formative feedback, identifies misconceptions, recommends revision activities, and supports students' self-assessment. Teachers remain responsible for evaluating higher-order learning outcomes, interpreting students' progress, and ensuring academic integrity.

Stage 5. Reflection and Continuous Improvement. The final stage focuses on reflection and continuous development. Students evaluate their learning achievements, identify strengths and weaknesses, and establish new learning goals. Teachers analyze learning analytics reports to improve instructional strategies, while institutional administrators use aggregated data to evaluate

the effectiveness of educational programs. The cyclical nature of the model ensures that each learning experience contributes to continuous improvement of both individual learning and pedagogical practice.

Discussion. The findings of this study indicate that artificial intelligence can improve the management of students' independent learning when it is integrated into an appropriate pedagogical framework. Instead of replacing teachers, AI should be used as a learning support tool that helps students plan their studies, receive personalized feedback, monitor their progress, and develop self-regulated learning skills. Recent studies similarly conclude that AI is most effective when it supports students' autonomy and complements sound teaching practices.

The proposed AI-SILMS model provides a structured approach to managing independent learning by combining five key stages: learning planning, personalized learning support, intelligent monitoring, formative assessment, and reflection. Unlike many existing studies that focus on a single AI application, this model integrates different AI functions into one pedagogical system, allowing teachers and students to work together more effectively.

The study also emphasizes that the successful use of AI depends on responsible implementation. Although AI can save time and provide instant support, excessive dependence on AI may reduce students' critical thinking and problem-solving abilities. Therefore, universities should encourage students to use AI as a learning assistant rather than as a substitute for their own thinking. Teachers should continue to guide students, evaluate learning outcomes, and promote academic integrity throughout the learning process.

Overall, the proposed AI-SILMS framework demonstrates that artificial intelligence can enhance students' independent learning by providing personalized support, continuous feedback, and learning analytics while maintaining the essential role of teachers. The model contributes to developing more autonomous, responsible, and digitally competent learners and offers a practical framework for integrating AI into higher education.

Conclusion. This study proposed an Artificial Intelligence-Based Students' Independent Learning Management System (AI-SILMS) to support the effective management of independent learning in higher education. The model demonstrates that AI can improve students' learning experience by providing personalized guidance, continuous feedback, and timely learning support while preserving the teacher's essential role as a mentor and facilitator. Recent studies similarly conclude that AI is most beneficial when it enhances self-regulated learning and complements, rather than replaces, effective teaching practices.

The study also highlights that successful AI integration requires responsible implementation, clear institutional policies, and the development of students' digital literacy and critical thinking skills. Universities should encourage the ethical use of AI as a learning assistant instead of a substitute for independent thinking. Future research may validate the proposed AI-SILMS model through empirical studies conducted in different higher education contexts and examine its impact on students' academic achievement, motivation, self-regulation, and lifelong learning competencies.

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