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The Dual Impact of Artificial Intelligence on Students' Autonomous Learning: A Self-Determination Theory Perspective

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Abstract. Artificial intelligence (AI), especially generative AI tools such as ChatGPT, has rapidly transformed modern education and students' learning behaviors. While AI provides students with convenient access to information, personalized feedback, and flexible learning support, its influence on students' autonomous learning in higher education remains controversial. Drawing on Self-Regulated Learning and Self-Determination Theory, this paper presents a theoretical analysis of the dual effects of AI on students' autonomous learning. Existing literature suggests that AI can strengthen self-directed learning, improve learning efficiency, and increase access to educational resources. However, excessive dependence on AI may weaken critical thinking, reduce independent problem-solving, and diminish meaningful interaction between students and teachers. This paper argues that AI itself is neither entirely beneficial nor harmful. Instead, its impact largely depends on how students use AI and how educators integrate it into learning environments. When AI supports rather than replaces thinking, it can enhance autonomous learning. Otherwise, it may encourage passive dependence. The paper also suggests ways to use AI responsibly, so that it supports learning without taking it over.

Keywords: Self-Regulated Learning, Self-Determination Theory, Artificial Intelligence, Autonomous Learning

1. Introduction

The rapid development of artificial intelligence (AI) has significantly transformed modern educational environments. Generative AI tools such as ChatGPT and DeepSeek are increasingly used by students for searching for information, generating ideas, explaining difficult concepts, and assisting with academic tasks. Compared with traditional educational resources, AI systems provide immediate feedback, personalized support, and flexible access to information, making learning more accessible and efficient.

However, concerns have emerged about students' increasing dependence on AI systems, particularly regarding critical thinking, independent problem-solving, and autonomous learning. Understanding its influence on students' learning behaviors has become an important issue in higher education research.

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Autonomous learning is widely regarded as a key objective of higher education because it reflects students' ability to regulate, monitor, and direct their own learning processes. Students who are capable of autonomous learning are generally better able to adapt to new challenges, maintain motivation, and continue learning beyond formal educational settings. Consequently, examining how AI affects autonomous learning is essential for understanding the broader educational implications of AI technologies.

This study combines Self-Regulated Learning (SRL) and Self-Determination Theory (SDT) as its main frameworks. SRL explains how students regulate learning through goal setting, self-monitoring, and self-evaluation [1]. SDT explains how the needs for autonomy, competence, and relatedness shape motivation [2]. Together, these theories cover both the behavioral and motivational sides of autonomous learning. This paper explores how AI affects autonomous learning through the three psychological needs, and identifies conditions under which AI supports or hinders it. Rather than viewing AI as inherently beneficial or harmful, this paper argues that its impact depends on how it is used. By applying both SRL and SDT, the study aims to offer a more comprehensive understanding of the opportunities and challenges in AI-supported learning.

2. Theoretical framework

2.1. Self-Regulated Learning

Self-Regulated Learning (SRL) refers to learners' ability to actively control and manage their own learning processes through goal setting, strategy selection, self-monitoring, and self-evaluation [1]. Zimmerman's cyclical model of self-regulated learning consists of three phases: forethought, performance, and self-reflection. During the forethought phase, learners establish goals, develop plans, and select learning strategies before beginning a task. During the performance phase, learners implement these strategies while monitoring their progress and regulating their behaviors. Finally, during the self-reflection phase, learners evaluate their performance, reflect on outcomes, and make adjustments for future learning activities. The concept of SRL highlights the importance of learner agency and responsibility. Previous research has consistently shown that self-regulated learners tend to demonstrate stronger academic performance and greater persistence when encountering difficulties [1]. Therefore, SRL provides an important theoretical foundation for understanding how students develop and maintain autonomous learning behaviors.

2.2. Self-Determination Theory

Self-Determination Theory (SDT) is a motivational framework developed by Deci and Ryan that explains how individuals become motivated to engage in various activities [2]. According to SDT, human motivation is influenced by the satisfaction of three basic psychological needs: autonomy, competence, and relatedness [2]. When these needs are fulfilled, individuals are more likely to experience intrinsic motivation, engagement, and psychological well-being.

Autonomy refers to the perception that one's actions are self-directed and reflect personal choice. Individuals who experience autonomy feel that they have control over their decisions and behaviors rather than being controlled by external pressures. Competence refers to the feeling of effectiveness and mastery when performing tasks. Individuals are more motivated when they believe they possess the skills and abilities necessary to achieve desired outcomes. Experiences of success and progress contribute to feelings of competence and encourage continued effort. Relatedness refers to the feeling of connection, belonging, and meaningful relationships with others. When learners feel

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connected to others, they are more likely to participate actively in learning activities and persist when challenges arise.

According to SDT, the satisfaction of autonomy, competence, and relatedness promotes intrinsic motivation, whereas frustration of these needs may reduce engagement and learning persistence. SDT provides a useful framework for understanding the psychological factors that influence autonomous learning.

2.3. Relationship between Self-Regulated Learning and Self-Determination Theory

Although Self-Regulated Learning and Self-Determination Theory originate from different theoretical traditions, they complement one another in explaining autonomous learning. SDT explains why students become motivated to engage in learning, whereas Self-Regulated Learning explains how learners regulate and manage their learning behaviors once motivation has been established.

Students who experience autonomy, competence, and relatedness are generally more likely to engage in self-regulated learning behaviors such as goal setting, self-monitoring, strategy use, and self-evaluation. For example, students who feel autonomous are more willing to take responsibility for their learning decisions, while those who feel competent are more likely to persist when facing academic challenges. Together, they provide a comprehensive framework for understanding both the motivational and behavioral processes. This paper uses both theories to analyze the dual effects of AI on autonomous learning.

3. Dual effects of artificial intelligence on students' autonomous learning

Artificial intelligence has become increasingly integrated into educational environments. Although AI offers numerous opportunities to enhance learning, its influence on autonomous learning is complex. From the perspective of Self-Determination Theory, AI may affect students' autonomy, competence, and relatedness in both positive and negative ways. Consequently, AI should not be viewed as either entirely beneficial or entirely harmful. Instead, its educational impact depends largely on how students use AI and how it is incorporated into learning environments.

3.1. Effects of AI on autonomy

3.1.1. Positive effects on autonomy

One of the most significant benefits of AI is its potential to support students' autonomy. AI-powered tools allow learners to access information independently, explore topics of personal interest, and receive explanations without relying on teachers or textbooks. As a result, students have greater control over when, where, and how they learn.

Holmes et al. suggested that AI-supported educational systems can promote personalized learning by adapting instructional content to individual needs and preferences [3]. This flexibility allows students to learn at their own pace and focus on areas requiring additional attention. Similarly, Chu and Chen argued that generative AI may strengthen students' self-directed learning motivation by providing immediate access to information and individualized assistance [4].

In addition, AI can encourage exploratory learning. Students can ask follow-up questions, request alternative explanations, and investigate unfamiliar topics without fear of embarrassment or judgment. This environment may increase learners' willingness to take initiative and assume

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responsibility for their own learning. However, as discussed below, these benefits depend on how students use AI; without reflection, the same tools can undermine autonomy.

3.1.2. Negative effects on autonomy

Despite these advantages, AI may also undermine autonomy when students become excessively dependent on it. Rather than using AI as a tool to support learning, some students may use it as a substitute for independent thinking. For example, learners may rely on AI-generated answers for assignments instead of developing their own solutions.

Kasneci et al. warned that excessive use of generative AI may discourage active learning behaviors and reduce students' willingness to engage in independent problem-solving [5]. Similarly, Tlili et al. argued that AI may encourage surface-level learning when students accept AI-generated responses without critically evaluating the information provided [6].

Over time, this dependence may weaken students' confidence in their own abilities and reduce their motivation to make independent learning decisions. Instead of regulating their own learning processes, students may increasingly rely on AI to determine what information is important and how tasks should be completed. Consequently, AI can reduce autonomy when it replaces rather than supports learners' decision-making processes.

3.2. Effects of AI on competence

3.2.1. Positive effects on competence

AI can also positively influence students' sense of competence. Because AI systems provide immediate feedback, personalized explanations, and adaptive support, learners can receive assistance whenever difficulties arise. Unlike traditional educational settings, where students may need to wait for instructors' responses, AI allows learners to obtain support instantly.

From the perspective of Cognitive Load Theory, human working memory has limited capacity. Learning becomes more effective when instructional methods reduce unnecessary cognitive burden and allow learners to allocate cognitive resources toward meaningful processing and schema construction [7]. AI may reduce extraneous cognitive load by simplifying complex information and providing targeted explanations. By reducing confusion and providing structured guidance, AI may allow students to focus their cognitive resources on understanding key concepts and solving problems.

Furthermore, personalized support may increase students' confidence in their academic abilities. When learners successfully complete challenging tasks with appropriate assistance, they are more likely to perceive themselves as competent and capable. This increased sense of competence may encourage persistence and engagement in future learning activities.

3.2.2. Negative effects on competence

Although AI can support competence, it may also create misleading perceptions of mastery. Students who frequently rely on AI-generated explanations or solutions may appear successful while failing to develop a genuine understanding of underlying concepts.

One concern is that students may develop an illusion of competence. Learners may believe they understand a topic because AI has provided accurate answers, even though they have not done the cognitive processes necessary for long-term learning. This weakens the self-reflection phase of SRL,

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where learners accurately evaluate their understanding. As a result, students may overestimate their knowledge and underestimate the effort required to achieve true mastery.

In addition, excessive AI support may reduce opportunities for productive struggle. Educational research suggests that learning often occurs when students actively grapple with difficult problems and persist despite challenges. If AI consistently removes obstacles from the learning process, students may lose opportunities to develop resilience, critical thinking skills, and deeper conceptual understanding.

3.3. Effects of AI on relatedness

3.3.1. Positive effects on relatedness

According to Self-Determination Theory, relatedness is a basic psychological need that supports intrinsic motivation. While AI cannot replace human relationships, it may support relatedness indirectly in certain educational contexts. AI can facilitate collaboration by helping with group tasks, such as brainstorming and project planning. By reducing routine tasks and providing organizational support, AI may enable students to devote more attention to collaborative learning activities. Furthermore, AI may increase accessibility to educational resources and support students who are hesitant to seek help from instructors or peers. For some learners, AI provides a low-pressure environment in which questions can be asked freely. This additional support may reduce anxiety and increase participation in learning activities. When students feel less anxious about asking questions and receive timely help, they are more likely to participate in class discussions and group work, which in turn strengthens their sense of connection with peers and teachers. Thus, while AI itself does not create human relationships, it can remove barriers that often block them.

3.3.2. Negative effects on relatedness

Despite these potential benefits, overuse of AI may reduce meaningful interaction between students and teachers as well as communication among peers. When students turn to AI for quick answers and feedback, they have less reason to ask a classmate or wait for office hours. For example, a student who used to discuss a confusing concept with friends after class might now just ask ChatGPT and move on. As learners increasingly turn to AI for explanations and feedback, opportunities for interpersonal engagement may decline.

Zawacki-Richter et al. suggested that AI technologies may fundamentally reshape teacher–student interactions in higher education [8]. While AI can provide efficient support, it cannot fully replace the emotional, social, and motivational functions of human relationships. Similarly, Selwyn argued that education involves more than information transfer; it also depends on mentorship, encouragement, and social connection [9].

If students rely mostly on AI rather than interacting with teachers and classmates, they may feel less connected to the educational community. Reduced interpersonal interaction may also limit opportunities for collaborative learning, peer feedback, and social support. Consequently, excessive AI use may undermine relatedness by weakening the human connections that contribute to effective learning.

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4. Discussion

4.1. Practical implications

For students to maintain autonomous learning, they should continue engaging in activities that require independent reasoning, problem-solving, and reflection. For example, learners may use AI to generate explanations or examples, but should attempt to solve problems independently before consulting AI-generated solutions. Similarly, students should verify information obtained from AI systems through textbooks, academic sources, and instructor feedback. In addition, students should regularly engage in self-monitoring and self-evaluation. Reflecting on what has been learned, identifying areas of weakness, and setting future learning goals remain essential components of self-regulated learning. AI can support these activities, but it should not replace them.

Educators should guide students toward responsible AI use by redesigning assessments to emphasize learning processes, such as oral presentations, reflective journals, and project-based learning, rather than focusing solely on final products. They should also encourage students to critically evaluate AI-generated content for accuracy, bias, and ethics. Strong interpersonal mentorship and support remain essential, as AI cannot fully replace them.

Institutions should implement AI literacy programs to help students evaluate AI outputs, recognize inaccuracies, and use AI ethically. Clear academic integrity guidelines and transparent policies can reduce uncertainty and ensure consistency. Providing instructors with resources to experiment with AI-supported teaching will help integrate technology while preserving the human aspects of education.

4.2. Limitations and future directions

This study is a conceptual analysis and is literature-based rather than empirical. First, the proposed AI–autonomous learning relationships cannot be directly verified with original data. Second, the focus on higher education means that effects may differ by educational level, age group, and learning environment. Third, AI tools evolve so quickly that long-term effects remain difficult to assess.

To address these gaps, future research should combine quantitative and qualitative methods. Longitudinal studies are especially valuable, as AI's effects on learning may emerge gradually. While short-term studies typically examine immediate academic results, long-term designs can track changes in motivation, learning habits, critical thinking, and academic performance over multiple semesters or years. Cross-cultural research would further clarify how AI affects learners across diverse educational settings. Finally, the ethical implications of AI in education, including academic integrity, algorithmic bias, privacy, and equitable access, deserve sustained investigation.

5. Conclusion

AI presents both opportunities and challenges for students' autonomous learning. Drawing on Self-Regulated Learning and Self-Determination Theory, this paper examines how AI influences the psychological needs for autonomy, competence, and relatedness, as well as the self-regulatory processes that support independent learning. The paper suggests that AI can positively contribute to autonomous learning by providing personalized support, immediate feedback, flexible access to information, and opportunities for self-directed exploration. These benefits may strengthen students' motivation, confidence, and ability to manage their own learning processes. However, the findings

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also indicate that excessive dependence on AI may undermine important aspects of autonomous learning. Overreliance on AI-generated responses may reduce independent thinking, discourage productive struggle, create an illusion of competence, and weaken meaningful interactions between students, teachers, and peers. These risks highlight the importance of using AI in ways that support rather than replace the cognitive and social processes involved in learning. By maintaining a balance between technological support and human-centered learning, educational systems can harness the benefits of AI while preserving the fundamental goals of autonomous learning.

This study has several limitations. It is a theoretical analysis based on existing literature. AI also evolves rapidly, making long-term effects unclear. Future research should use longitudinal and cross-cultural designs to test how AI use patterns influence autonomous learning over time. Ethical issues also need further investigation. Balancing technological support with human-centered learning will help preserve the fundamental goals of education.

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