

The Role of Artificial Intelligence in Enhancing Student Engagement in Higher Education

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Abstract

Student engagement has been perceived as a key factor of persistence, academic success, and satisfaction in higher institutions of learning and entails behavioral, emotional, and cognitive aspects that concurrently determine how students learn. In the last ten years, AI has transitioned from being viewed as a peripheral experimental tool into a widely adopted tool in higher learning where it contains platforms for learning, chatbots and learning aids like ChatGPT. While the AI tools continue to develop, research indicates inconsistencies on the role of AI in redefining the multidimensional construct of engagement. AI-based tools can enhance behavioural and cognitive engagement via personalization, providing real-time feedback. Conversely, the impacts on emotional engagement are varied and dependent on pedagogical design, institutional context, and student wellbeing aspects like overreliance and technostress. The paper examines recent empirical and conceptual literature on AI and student engagement in institutions of higher learning, via narrative and thematically presented synthesis, relying on past systematic reviews, theoretical frameworks and mixed-methods primary research from 1999-2025. It confirmed that the use of AI-based tools improves cognitive and behavioral engagement through real-time feedback and personalization, whereas the effect on emotional engagement changes based on the design of pedagogy, institution and mental wellbeing. It highlights gaps, including the scarcity of longitudinal and causal lenses, international student populations, and the weak theoretical link between engagement and AI in education. Future research needs to focus on longitudinal, theory-driven, and context-sensitive studies to examine the influence of pedagogical approaches on the effect of AI on engagement.

Keywords

artificial intelligence, student engagement, behavioral engagement, emotional engagement, cognitive engagement

1. Introduction

Student engagement is known as one of the levers for enhancing, achievement, retention, and mental wellness in institutions of higher learning. After Astin's [1] foundational theory of student involvement and Kuh's [2] research on the National Survey of Student Engagement, researchers have viewed engagement as a dynamic construct that is a function of the relationship between the student and the learning environment, rather than a fixed trait. Fredricks et al. [3] elaborated the construct by explaining the three types of engagement, and this tripartite framework is the basis for most recent studies where institutions of higher learning have

gone through change, thanks to artificial intelligence (AI). Beginning as a simple experiment with integrated intelligent tutoring systems, AI has developed into a broad ecosystem of adaptive learning platforms, dashboards analytics models, AI-driven chatbots, and AI tools like ChatGPT, which are currently integrated in everyday learning and teaching [4,5]. Since 2022, generative AI has spread so rapidly that there has been a surge of empirical research that looks at its impact on the student experience [6,7], yet existing findings remain inconsistent. However, the linkage between AI and student engagement is still conceptually and empirically difficult to understand. Past studies could not distinguish between whether AI tools enhance students' engagement behaviour, emotional investment, or cognitive effort, or create more superficial engagement, like login frequency or completing tasks. As AI-related studies continue to grow, Bond et al. [8] explained that the issue of inconsistencies in definition also becomes a challenge in the field of educational technology research. The aim of this review is to address the existing gap by asking three questions. How have past studies on higher learning conceptualized student engagement, and in which ways do existing models integrate AI-mediated learning? What does the latest empirical evidence indicate on the effects of AI tools on behavioral, emotional, and cognitive engagement? What theoretical and methodological gaps restrict current understanding, and what should future research focus on? The review is significant because it harmonizes the basic principles of engagement theory with the latest research on AI in education, most of which was published in 2025, when institutions are making fast and high-stakes moves on the use of AI with limited guidance on longitudinal research. The rest of the paper proceeds as follows. In the second section, the paper outlines theoretical background and defines engagement before discussing AI in the context of current educational technology. In the third section, the paper thematically reviews literature and discussion is done in the order of behavioral, emotional and cognitive engagement. The paper then synthesizes evidence and critiques in the fourth section and concludes with implications for future research and practice in the fifth section.

2. Theoretical Background

2.1 Student Engagement Theories

The concept of student engagement is well explained through the tripartite model, developed by Fredricks et al. [3], who break it down into the three components of behaviour, emotion, and cognition. Behavioural engagement relates to observable behaviours, including attendance, effort, and academic and co-curricular engagement. Emotional engagement involves students' responses to learning, such as showing interest, a sense of belonging and enjoyment, with no signs of anxiety or alienation. Cognitive engagement denotes the psychological investment students make in mastering difficult content, which involves self-regulation, strategic thinking, and going beyond the minimum requirements. This three-part framework is now a widely accepted tool for engagement research since it does not reduce engagement to a single, gameable metric, and it enables researchers to pose separate questions on the impact of any intervention including AI on each dimension. As a complementary model, Astin's [1] theory of student involvement views involvement as a function of the amount of physical and psychological energy that students invest in their educational process, and posits that the more energy students invest, the more successful the institution will be in terms of students' engagement. Similar concepts were operationalized at the institutional level by Kuh's [2] engagement indicators, which focused on the quality of student-faculty interaction, student learning, and student campus environments as proxies for the quality of engagement.

2.2 Theoretical Perspectives of AI in Education

Situating AI in this theoretical framework calls for a second body of scholarship encompassing educational technology. Holmes et al. [4] explain three ways to engage with AI and they include AI functions as a substitute for human instruction, AI that guides lecturers, and AI that empowers learners as active participants in their own learning. This distinction is significant since each mode means different pathways to engagement. Williamson and Eynon [5] warn against perceiving the use of AI in education as novel, claiming that rather, it inherits historical assumptions about learning, measurement, and control from past waves of innovation in education. The historicized perception is important in understanding reasons why some AI application outputs are narrow, and produce behaviorist notions of engagement, like time-on-task, instead of richer emotional or cognitive forms. There is a big debate in the field, on whether there is a need to have any existing engagement models for AI-mediated contexts. In contrast, Bond et al. [8] discovered that in educational technology research,

engagement is often conflated with other constructs or related constructs like motivation, satisfaction or usage, which is a problem AI studies may be prone to falling into when relying on log data like clicks or session length as a proxy for engagement.

3. Literature Review

3.1 Foundations and Evidence

Prior to the development of AI-specific research, there was a robust body of evidence in the field of educational technology and engagement. The systematic evidence map of student engagement and educational technology in higher education undertaken by Bond et al. [8] is a synthesis of hundreds of studies that identified the relative lack of adequate research in emotional engagement and cognitive engagement. This imbalance has persisted into contemporary AI research, where metrics, task completion, and time-on-task login remain convenient but narrow proxies for engagement. Additionally, Bond et al. [8] found a lack of adequate research on engagement theory, which is also observed in some of the reviewed AI literature presented below, in which engagement is interpreted as satisfaction or usage. Such research biases continue to affect current AI-related studies on student engagement, discussed in the following subsections.

3.2 AI and Behavioral Engagement

There is consistent evidence that AI has positive impacts in terms of behavioral engagement. Intelligent Tutoring Systems (ITS) and Adaptive Learning Platforms (ALP) provide a personalized approach to pacing and sequencing learning, which typically leads to higher rates of time-on-task and completion, as the pace and sequencing match the student's current level of mastery [4]. This personalization has spread to generative AI tools. Al Mashagbeh et al. [6] in a survey of Jordanian university students revealed that the overwhelming majority of students had used AI tools like ChatGPT and Meta AI to write assignments and homework, and the majority of them said they benefited by finishing their assignments faster. In another systematic review of seventy-three peer-reviewed studies on AI tools in education, Long et al. [7] found that AI tools, including both chatbots and adaptive systems and predictive analytics, showed a positive relationship with behavioral participation, especially within interactive pedagogies like flipped classrooms and project-based learning (PBL) instead of as isolated add-ons. Both studies ignite some qualifications. Nearly all students viewed AI tools as having a positive impact on education, but a simple majority saw measurable improvements in their academic performance, indicating there is no direct link between the use of an AI tool and deeper learning [6]. A similar conclusion was drawn by Long et al. [7] in their Pedagogical Mediation of AI for Student Engagement (PMAISE) model, which suggests that the behavioral effect of AI on student engagement depends on how instructors apply the tools when designing the course.

3.3 AI and Cognitive Engagement

The literature suggests a more complex picture for cognitive engagement, defined as self-regulation and strategic effort. Holmes et al. [4] suggest that the type of metacognitive activity that involves planning, monitoring, and revising strategies and thinking about one's own work is more likely to occur when students work as agents of their learning in using AI systems instead of as mere consumers. Long et al. [7] reported this in their review in which AI tools with scaffolded feedback loops demonstrated higher cognitive engagement results than AI tools alone, as the scaffolding encouraged reflection on the feedback and not passively taking it in. Concurrently, another thought is circulating in the literature on cognitive offloading, where students might delegate effortful thoughts to AI to do it. However, as the mini-review by Klimova and Pikhart [9] on the impacts of AI on the well-being of students and teachers highlights, while AI can enhance personalized learning and improve efficiency in communication, there are concerns over the potential loss of human interaction and the decrease in independent student work, which may hinder deeper cognitive engagement despite the apparent progress on task completion. This balance between efficiency and depth is one of the more salient and unanswered questions in the literature: While the reduction of cognitive effort needed to complete a task can be beneficial for accessibility and confidence, it can also be detrimental to strategic thinking, which is the intent of using cognitive effort.

3.4 AI and Emotional Engagement

Emotional engagement provides the least consistent results across the three dimensions. Al Mashagbeh et al. [6] reported that while a significant proportion of Jordanian students perceived using the AI tool as positive emotional experiences, such as decreased anxiety with challenging tasks and greater confidence in handling content they are not familiar with, this was not the case for others. Like the PMAISE model, Long et al. [7] confirmed that the affective and behavioral dimensions of engagement were enhanced when the AI tools were integrated into engaging pedagogies. However, Klimova and Pikhart [9] offer a cautionary appeal, noting that while AI can be useful, in terms of education, mental health, and other areas, it can also cause issues like digital fatigue, loneliness, and technostress. They point out that in some instances, overreliance on AI tools can reduce the human touch, emotional intelligence, and interpersonal skills, leading to a sense of isolation for some students, especially when AI is used instead of other students or instructors. Examining how international students experience culturally engaging campus environments, Glass et al. [10] identified that identity, status and relational belonging play as much a role in engagement as do academic tasks, and that if international students are not able to access the social and emotional supports that promote a sense of belonging, then AI tools that focus on a transactional, task-completion model risk further decontextualizing engagement. Such group differences also expose methodological limitations of current research, which will be discussed in the next subsection.

3.5 Methodological Patterns across Studies

When analyzed, these studies indicate a methodological trend that captures attention prior to focusing on the discussion. Bond et al.'s [8] evidence map and Long et al.'s [7] systematic review depend on large-scale synthesis of mainly cross-sectional, survey-based, or short-duration studies. The two reviews clearly point to the scarcity of longitudinal designs to track student engagement as students use AI tools in a semester or entire degree program. Al Mashagbeh et al. [6] and Klimova and Pikhart [9] similarly rely on survey and mini-review methods instead of experimental or longitudinal information, limiting causal claims. It is still unclear whether AI tool use increases engagement, whether already-engaged students are more likely to adopt AI tools, or whether some third factor, such as digital literacy or institutional support, drives both. This methodological ceiling is evident in almost all studies reviewed here and limits how confidently the field can currently answer the question in the introduction.

3.6 Historical and Critical Perspectives

Williamson and Eynon's [5] historically informed analysis is a significant dimension to this thematic literature. They assert that perceiving the use of AI in education as a novel technology restricts the continuities with past innovations in educational technology movements, many of which promised similar gains in engagement and personalization but resulted in mixed outcomes shaped by incentives, data infrastructures, and commercial interests. Based on the engagement literature examined above, this viewpoint indicates that some AI tools may be designed to optimize measurable proxies of behavioral engagement, like usage metrics that are commercially significant to report, and not advancing the emotional and cognitive aspects that are important for genuine learning. This analytical perspective is in line with the empirical research of Al Mashagbeh et al. [6], Long et al. [7], and Klimova and Pikhart [9], which collectively point to a rich empirical literature that finds it difficult to distinguish authentic multidimensional engagement from AI-driven activities that only simulate engagement.

4. Discussion & Synthesis

In the literature, what comes out clearly is not just contradiction on what occurred, instead, it is on the implications. Whereas some scholars deduce that the use of AI tools greatly correlates with student engagement, others perceive it as authentic engagement and some see a real quantifiable measure of compliance with the use of AI tools, but provide few facts about learning. This section intends to explain the existing gaps in terms of four sources of interpretive conflict that exist across the field. The first source is based on definition. According to Fredricks et al.'s [3] explanation, of engagement, behavior is the only observable sign of all three. Al Mashagbeh et al. [6] and Long et al. [7] operationalize engagement in terms of behavioral proxies, for example, usage logs and self-reported task completion since that is the data produced by AI platforms.

Williamson and Eynon [5] regard the very same proxies as something that is being measured and reported by commercial platforms, rather than as neutral measures of a psychological state. When two scholars use the term "engagement" with two different definitions for the same set of facts, one to describe the facts and the other to deconstruct them, they don't mean the same thing with different data, but rather pose different questions with the same data. The second source is on a theoretical starting point. Research based on implementation for example Long et al.'s PMAISE model and Al Mashagbeh et al.'s [6] survey, enquires on the conditions under which a tool produces positive outcomes. Williamson and Eynon's [5] enquiry into trends that would link the recent use to past adoption of technology waves that shared the same objectives, but have been used for commercial and institutional purposes, rather than student learning. A study on well-being like Klimova and Pikhart's [9], reports emerging risks of isolation and technostress. While none of these starting points can be dismissed, each of them is designed in such a way that they have a particular conclusion even before empirical data is examined, making the conflict common in the upstream of the data in the question it intends to address instead of what it revealed. The third source is on the methodological design. The evidence base is overwhelmingly comprised of cross-sectional surveys and short-term systematic reviews, and is limited in longitudinal studies tracking engagement trajectories over time. The design is not able to help understand whether the use of AI tools leads to an increase in engagement or if the students who are already engaged can keep using AI tools. Lastly, there exists significant variation across the three dimensions of emotional engagement and it is due to population and context. Al Mashagbeh et al. [6] report mostly positive emotional reactions when teaching with AI is applied to Jordanian students, Klimova and Pikhart [9] report emerging risks of isolation and technostress in a broader higher education population, and Glass et al. [10] point out the importance of culturally responsive, relational campus environments that current AI tools are not generally capable of delivering for international students. These are not contradictory statements but complementary, reflecting the fact that the extent to which emotional engagement outcomes are positive or negative is reliant on context, influenced by the existing support system laid down by the relevant institutions, culture and the degree to which AI tools tend to support versus replace human engagement. Therefore, these sources imply that the contradictions in the field emanate from unexamined variations in definitions, the context of the sample, starting points, and design. Future research cannot address this disagreement through the use of a similar approach, but must be clear on what they understand by the term engagement, the design, and context prior to making a small sample a representative of the effects of AI on students' engagement as a whole.

5. Conclusion

The review aimed at exploring the concepts of student engagement in the higher education literature, the research evidence on the impact of AI on students' behavioral, emotional, and cognitive engagement, and the research gaps. Drawing on the tripartite model, this review revealed that AI tools are most consistently aligned to behavioral engagement gains, especially when within interactive, well-designed pedagogies instead of being used as standalone add-ons. Besides, the review has revealed that there is tension in the evidence on cognitive engagement, between AI's ability to support strategic thinking and its ability to facilitate cognitive offloading. The review's core theoretical contribution entails redefining the discussion on AI use and engagement as a question that needs further interpretation before focusing on the direct effect. A closer examination of engagement theory reveals that behavior cognition, and emotion are regarded as interrelated but have different psychological states. The synthesis reveals that studies on AI are yet to come to a general conclusion, often putting all three dimensions in behavioral proxies that can be measured easily. The contradictions in the literature are indicative of how the scholars have different viewpoints on engagements, the theoretical standpoints they incorporate in the research, and the methodological designs that are appropriate for their inquiry. A practical implication of this review is a modest approach where teachers and institutions need to approach AI benefits with caution. This is because the effectiveness relies mainly on the way the AI tool is integrated into a course rather than the technology. Future studies should focus on longitudinal designs that can capture the patterns of engagement as students develop their sustained experience with the use of AI tools. Comparisons of engagement across a range of institutional, country, and cultural settings should also be conducted to determine if results obtained from single-country samples can be generalized, and to establish theory-driven operational definitions of engagement that allow meaningful comparisons across studies.

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Conflicts of Interest

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