Chapter 1
Understanding Student Engagement in AI-Powered Online Learning Platforms:
A Narrative Review of Key Theories and Models

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EXECUTIVE SUMMARY

Online learning has become fundamental to modern academic and professional development. Amidst its widespread adoption, there is increasing integration of

DOI: 10.4018/979-8-3693-5633-3.ch001

artificial intelligence (AI) to enhance the learning experience. Understanding student engagement within these AI-powered digital platforms is crucial, as it directly influences learning outcomes and satisfaction. This chapter provides a narrative review of key theories and models essential for analyzing engagement in virtual learning contexts. Particularly, it focuses on constructivist learning theory, social learning theory, cognitive load theory, flow theory, technology acceptance model, self-determination theory, cognitive theory of multimedia learning, and feedback intervention theory. By examining these frameworks through an epistemological lens, the chapter explores how knowledge acquisition, cognitive processing, and social learning principles interact within AI-enhanced educational contexts. The insights reported here can serve as a guide for optimizing AI to maximize student involvement and educational efficacy.

INTRODUCTION

The educational landscape has been undergoing extensive transformations. Due to recent and constant disruptions to physical classes, online learning is emerging as a dominant mode of instructional delivery. The COVID-19 pandemic, in particular, accelerated the shift toward digital education (Bozkurt et al., 2022; Ofosu-Ampong et al., 2024). This change compelled institutions worldwide to adapt quickly to emergency remote teaching and learning methods. This transition highlighted the flexibility and accessibility of online learning, making it an attractive option for students and educators alike (Betthäuser et al., 2023). With technological advancements and increasing internet accessibility, online learning has evolved from a supplementary tool to a primary mode of education delivery. It has democratized education by providing opportunities for learners from diverse geographical locations and backgrounds, allowing them to access high-quality educational resources and instruction without the constraints of time and place. Consequently, online learning has not only become more prevalent but also more sophisticated, incorporating a range of interactive and personalized learning experiences (Iyer et al., 2022).

In online learning, student engagement is one of the critical factors for determining the effectiveness of the educational experience (Aliyu et al., 2022). Student engagement refers to the level of interest, curiosity, and participation that students exhibit in the learning process. It encompasses emotional, behavioral, and cognitive dimensions, influencing how students interact with the course content, their peers, and instructors (Reschly & Christenson, 2012). Engaged students are more likely to retain information, perform better academically, and develop essential skills such as critical thinking and problem-solving (Bond et al., 2020; Li & Xue, 2023). Fostering engagement in online learning contexts is particularly important due to the lack of physical presence, face-to-face interaction, and the natural social cues inherent in traditional classroom settings. Without these elements, students may feel isolated or disconnected, which can hinder their motivation and learning outcomes. However, implementing well-designed strategies (e.g., interactive multimedia, real-time feedback, collaborative projects, and personalized learning paths) can significantly enhance student engagement and mitigate some of the challenges of online learning (Garcia & Yousef, 2022; Shively & Sydnor, 2023; Yousef et al., 2023). By actively involving students in their learning journey, online education can create a more immersive and effective learning environment. These engagement-focused strategies help online learning become not only a viable but a potentially transformative educational experience.

In recent years, artificial intelligence (AI) has seen rapid advancements and its integration into online learning has opened up new opportunities for enhancing the educational experience (Garcia, Arif, et al., 2024; Lobo, 2023; Tavares et al., 2023). These developments have been particularly accelerated by the emergence of generative AI (Bozkurt & Sharma, 2024). For instance, AI can personalize learning experiences by analyzing student data to provide tailored content, instant feedback, and adaptive assessments that meet individual learning needs. Additionally, AI-driven tools such as ChatGPT can facilitate more interactive and engaging learning environments by enabling virtual tutoring, answering student queries in real-time, and offering simulations and immersive experiences that deepen understanding. The integration of AI in online learning presents a significant opportunity to boost student engagement. AI can be used to foster dynamic and interactive learning experiences that keep students motivated and invested in their education. By leveraging AI, educators can design learning activities that are not only informative but also engaging, encouraging active participation and continuous interaction. However, while the potential benefits of AI in enhancing student engagement are promising, there is a need for more comprehensive studies to understand its full impact. Research is essential to explore the best practices for implementing AI in online learning and to address any challenges related to equity, ethics, and effectiveness. By studying the role and impact of AI-driven online learning in student engagement, educators and policymakers can better harness its capabilities to improve educational outcomes and create a more engaging learning environment.

Main Focus of the Chapter

Understanding student engagement is a pivotal aspect of educational research as it significantly influences academic outcomes and the overall effectiveness of learning environments across all levels (Aliyu et al., 2022). Engagement in educational settings is multifaceted, involving cognitive, emotional, and behavioral components that collectively contribute to successful learning experiences. With numerous theoretical frameworks available, selecting the most appropriate one is crucial for effectively analyzing and enhancing student engagement. This chapter aims to dissect common theoretical frameworks employed in educational studies that may be used to understand how AI tools like ChatGPT can enhance student engagement. The significance of this chapter extends beyond theoretical exploration as it has practical implications for designing AI-powered educational tools that are both engaging and effective. By providing empirical insights into how AI can enhance key aspects of student engagement, the study contributes to the ongoing development of more adaptive, responsive, and inclusive educational environments. Furthermore, this chapter aims to inform policymakers and educational technologists about the optimal integration of AI across educational levels, ensuring that these technologies are used to their fullest potential to enhance both teaching and learning processes. This contribution is essential for advancing the field of educational technology and for supporting sustained student engagement in an increasingly digital learning landscape.

AI AND CHATGPT INTEGRATION IN EDUCATION

Introduction to AI Integration in Education

Integrating AI into the educational landscape represents a transformative shift in pedagogical methodologies and the administration of educational institutions (Ikedinachi et al., 2019; Rosak-Szyrocka, 2024). AI refers to the simulation of human intelligence processes by machines, especially computer systems, which include learning, reasoning, and self-correction. The purpose of AI in this context is to enhance educational outcomes and streamline both teaching and administrative processes (Okewu et al., 2021). Educational AI can adapt to various learning environments, accommodating individual learning styles and needs by analyzing data points related to student performance and engagement (Akavova et al., 2023; Arif et al., 2024). This adaptive learning technology not only supports personalized education but also empowers teachers by providing them with actionable insights. For instance, AI systems can identify patterns and trends in student data that are not immediately obvious, enabling educators to tailor their teaching strategies to individual students' needs and psychological traits more effectively (Sidekerskienė et al., 2021). AI's impact on education extends beyond personalized learning. It automates administrative tasks such as grading and scheduling, thus freeing educators to focus more on teaching and less on bureaucratic tasks. AI also facilitates scalable educational practices that can reach a wider audience with consistent quality. For example, AI-driven platforms can deliver instructional content to remote or underserved populations, breaking down geographical and socio-economic barriers to education (Iyer et al., 2022). The scope of AI's application in education is vast and varied, involving stakeholders at all levels, from policymakers and educators to students and parents. As AI continues to evolve, its role in education is expected to expand, driving innovations that could redefine traditional educational paradigms.

Roles of AI in Education

The deployment of AI in education has several pivotal roles that collectively aim to enhance the efficacy and accessibility of learning. One of the primary roles of AI in education is to facilitate personalized learning experiences. AI systems achieve this by analyzing vast amounts of data regarding individual student behaviors, learning patterns, and academic performance. These systems can tailor educational content by leveraging algorithms to match each student's unique needs and learning speeds. This individualized approach helps to maximize student engagement and retention rates, addressing the diverse learning styles and capacities present in any educational environment (Valderama et al., 2022). AI also plays a role in automating routine tasks that traditionally consume significant amounts of educators' time and energy. For example, VD-CAI (Garcia & Garcia, 2023), an intelligent tutoring system, provides personalized learning guidance in nutrition education. Furthermore, AI-driven tools can assist in creating and managing schedules, coordinating resources, and maintaining records, thus reducing administrative burdens and allowing educators to devote more time to direct student interaction and instruction (George & Wooden, 2023). Another role of AI is its function as a tutoring and support tool. AI tutors can support students by offering explanations, supplementary lessons, and practice exercises, which help reinforce learning outside the traditional classroom setting. AI also contributes to data-driven decision-making in educational institutions. By analyzing data on student performance, attendance, and even social-emotional factors, AI tools can help educators and administrators make informed decisions that improve educational outcomes. These systems can identify at-risk students, suggest areas where resources are needed, and even predict future trends in student performance (Waheed et al., 2020). As AI technology evolves, its roles in education bring about more changes to educational systems worldwide. These developments promise to enhance how education is delivered and managed and democratize access to quality education, making it more inclusive and equitable, thus contributing to the UN’s Sustainable Development Goals (SDGs).

Capabilities of ChatGPT in Education

ChatGPT, a variant of the Generative Pre-trained Transformer models developed by OpenAI, exemplifies the integration of advanced AI in educational contexts. This tool is designed to understand and generate human-like text based on user input. The capabilities of ChatGPT in education are manifold and cater to various aspects of the learning experience. One of the fundamental capabilities of ChatGPT is its role in interactive learning. Through natural language processing (NLP), ChatGPT can engage with students in a conversational manner (Garcia, 2023a). This feature allows ChatGPT to serve effectively as a virtual tutor, providing explanations, guiding through problem-solving steps, and answering real-time questions. Such interactions can make learning more engaging for students, particularly in remote or asynchronous learning scenarios where direct human interaction is limited (Chen et al., 2023). Its advanced text generation capability may also assist in curriculum development and content creation. For instance, it can generate reading comprehension exercises, create practice test questions, or even simulate historical dialogues for social studies classes. This approach can significantly reduce the time educators spend on content creation, allowing them to focus more on pedagogy and student engagement (Yadav et al., 2023). The integration of ChatGPT with other educational software and platforms further expands its capabilities. For instance, embedding ChatGPT in learning management systems (LMS) can streamline communication between students and educators, facilitate the feedback automation of assignments, and personalize study resources for individual learners based on their progress and performance. Such integration enhances the scalability of personalized education, as demonstrated by the potential of ChatGPT to serve as a virtual assistant in various educational settings (Ibrahim et al., 2023). As AI continues to evolve and become more sophisticated, its impact on educational practices is expected to grow, offering a broader audience more advanced, efficient, and tailored educational experiences.

Current Practices and Advancements in AI and ChatGPT

Applying AI tools in education has led to innovative practices across various educational landscapes (Miller et al., 2025; Wang et al., 2024). One of the prominent approaches is the utilization of AI for personalized learning experiences. Educational institutions increasingly adopt AI-driven platforms that analyze student data to adapt curriculum pacing, content complexity, and learning styles tailored to individual needs. These systems adjust in real-time, providing students with a personalized learning trajectory that optimizes their understanding and retention of knowledge. For example, AI systems are being used to identify learning gaps and automatically suggest targeted educational resources and activities to address these deficiencies. This transformation is supported by research showing how AI can enhance e-learning modules and the development of AI-powered virtual tutors while also addressing the ethical challenges these technologies may bring. Additionally, integrating adaptive learning technologies with AI algorithms is revolutionizing traditional teaching methods by personalizing and enhancing the learning experience for students (Akavova et al., 2023). These advancements are paving the way for more effective and personalized educational environments, highlighting the broad impact of AI in reshaping how educational content is delivered and interacted with. ChatGPT has also been instrumental in advancing the role of AI as a facilitator of interactive and accessible education beyond traditional practices (Damaševičius, 2023). Universities and online course providers are employing ChatGPT to create virtual teaching assistants. These AI assistants handle student queries, provide explanations for complex topics, and even manage administrative tasks like grading assignments and scheduling feedback sessions. Integrating AI and ChatGPT into educational systems has also sparked advancements in data-driven decision-making (Okewu et al., 2021). Educational administrators are utilizing AI to analyze patterns and trends from large datasets of student performance, enabling informed decisions that enhance educational outcomes and operational efficiency. One example includes using predictive analytics to forecast student success rates and identify potential dropouts with ease (Shoaib et al., 2024).

REVIEW OF THEORETICAL FRAMEWORKS

Constructivist Learning Theory

As an educational philosophy, constructivism suggests that learners create their own knowledge through experiences and reflection (Bruner, 1996; Piaget, 1997; Vygotsky, 1978). Learners integrate new information with existing knowledge, altering or reinforcing their existing frameworks (Seraji & Musavi, 2023). This theory advocates for the view that individuals are not merely passive recipients of information but active participants in constructing their own understanding (Cooperstein & Kocevar-Weidinger, 2004). From an educational practice standpoint, constructivism influences teaching methodologies by highlighting the proactive role of learners in shaping their educational journey and interpreting information (Liu & Matthews, 2005). This approach promotes engaging students in problem-solving tasks, inquiry-based activities, and discussions, enabling them to apply known concepts to new scenarios and thus deepening their understanding (Porcaro, 2011). AI can leverage algorithms to provide personalized feedback, effectively adapting to each student's unique learning needs and prior knowledge (Garcia, 2023b; Lin et al., 2023). This transformative capability enables a shift from one-size-fits-all education models to highly individualized learning experiences.

Maier and Klotz (2022) discussed the effectiveness of personalized feedback mechanisms within digital learning environments. They outline how adaptive feedback can dynamically respond to student interactions, tailoring instructional content to optimize learning outcomes. Similarly, Chang et al. (2023) emphasized that AI-driven chatbots supporting self-regulated learning can foster a personalized educational journey. These chatbots engage students in real-time dialogue, akin to a one-on-one tutoring session. This interaction allows chatbots to provide immediate feedback based on the student's responses, helping to assess their understanding and tailor the educational content accordingly. The concept of real-time feedback is central to the effectiveness of chatbots in education. Prior research underscores how such immediate feedback can support self-regulated learning, enabling students to monitor their progress and adjust their learning strategies effectively (Chang et al., 2023). These systems adapt to learner input, assist in goal setting, and align educational materials with learner needs. Implementing AI also facilitates the linkage of new knowledge with what students already know. For instance, Bhutoria (2022) reviewed personalized education applications in the U.S., China, and India, noting that AI's predictive analytics are crucial for developing personalized learning pathways that encourage a deeper connection with existing knowledge bases. Kochmar et al. (2020) also demonstrated that automated personalized feedback systems in intelligent tutoring scenarios enhance student learning outcomes and engage students more deeply by providing timely, relevant feedback that resonates with their existing knowledge and learning objectives. Through these examples, AI algorithms are pivotal in creating adaptive learning environments that personalize education.

AI Integration: Using a constructivist approach, AI-driven virtual tutors can provide students with personalized learning experiences based on students' prior knowledge and skills. Adaptive learning platforms, for example, can present tailored challenges and scaffold instruction to support the construction of new knowledge.

Practical Example: An AI tutor assesses a student's current understanding of a math concept and provides customized problems that progressively build on their knowledge while offering useful hints and feedback along the way (Lenat & Durlach, 2014).

Social Learning Theory

Social learning theory, developed by Albert Bandura (1969), emphasizes that learning in school occurs through direct instruction, observation, imitation, and modeling. This theory highlights the interplay between cognitive, behavioral, and environmental influences, stressing the role of observed behavior in the educational process. It also elaborates on how students learn behaviors, skills, and attitudes by observing their peers, teachers, and other influential figures within the school environment. It was suggested that students are more likely to emulate behaviors that lead to positive outcomes, thereby underscoring the importance of providing positive role models in educational settings (Horsburgh & Ippolito, 2018). Learners adopt new behaviors that are modeled on them by observing and regulating their incentive systems, namely, changing perspectives of potential outcomes when observing benefits to others (Bandura, 2001). Students learn social norms and behaviors appropriate to their culture and societal expectations through imitation. This aspect of learning is crucial during early educational experiences and continues to be important as students advance through different educational levels. Imitation helps inculcate values, etiquette, and the interpersonal skills necessary for successful interaction within a school environment and beyond. It also supports cognitive development by encouraging students to think critically and solve problems as others have modeled, including academic tasks and strategies for learning, such as note-taking, organizing information, and critical thinking. These cognitive skills are essential for academic success and lifelong learning.

AI tools such as ChatGPT can simulate social interactions through conversational interfaces (Garcia, 2023b), allowing students to engage in dialogues that mimic peer interactions, thus enhancing learning through discussion and exchanging ideas. For example, web-based learning environments can utilize AI to model educational behaviors and interactions, enhancing student engagement and fostering a deeper understanding of the material through observed behaviors. In such settings, AI can function as both a facilitator and a learner—modeling appropriate educational behaviors and adapting to the varying pedagogical needs of students, thus fostering a more engaging and personalized learning experience. AI can tailor educational experiences to individual learners by analyzing their previous interactions and predicting what types of observation may lead to positive learning outcomes. Through adaptive learning systems, AI can present personalized examples and role-modeling behaviors from which learners can draw vicarious lessons. This customization enhances engagement and relevance, which are critical for effective learning. AI can generate sophisticated simulations and virtual environments that allow students to observe and imitate complex processes and behaviors. These simulations are integrated into educational settings to enhance both technical and non-technical skill acquisition (Komasawa & Yokohira, 2023), allowing students to experience realistic scenarios that may be difficult or impossible to replicate in a traditional classroom, providing a deep understanding of the subject matter through immersive learning experiences. Additionally, according to Jung et al. (2020) and Kuhail et al. (2023), AI chatbots can simulate the social dynamics of human interaction, enhancing the learning experience through simulated social learning environments and engaging students in meaningful dialogues akin to those between peers, making the educational process more dynamic and closely mirroring the interactive nuances of peer learning.

AI Integration: AI can facilitate social learning through virtual collaboration tools and intelligent agents that promote interaction and peer learning.
Practical Example: Students participate in virtual group projects while using AI tools that strengthens communication, collaboration, and peer feedback, thus mimicking the social learning process in a digital environment (Lee et al., 2024).

Cognitive Load Theory

Cognitive Load Theory (CLT) has emerged as a crucial theoretical paradigm for understanding how students absorb information in classroom environments (Paas & Ayres, 2014). By controlling the cognitive demands made on learners, CLT offers insights into creating more successful learning experiences, especially when combined with AI technologies (Rosak-Szyrocka et al., 2023). According to CLT (Sweller, 1988), instructional designs must match the human cognitive architecture for effective learning to occur. Cognitive load is divided into three categories: (1) intrinsic load, which is the intrinsic challenge of the subject matter, where complex sciences like quantum physics naturally require greater mental capacity than simpler subjects; (2) extraneous load, which refers to the cognitive burden introduced by the method in which knowledge is imparted to students, where a poor instructional design may increase the unnecessary load, impeding learning by making information retrieval and processing more challenging; and (3) germane load, which pertains to the mental effort focused on constructing information and forming significant connections, with effective instructional design enhancing germane load to promote understanding and deep learning.

Adapting to these cognitive demands becomes both challenging and advantageous in online learning environments. AI can tailor the complexity of content to ensure that the intrinsic load corresponds to the learner's current capability level. This feature optimizes the degree of difficulty to prevent learner overload (Koć-Januchta et al., 2022). AI-powered systems, such as ChatGPT, can dynamically adjust the presentation of information to minimize unnecessary cognitive strain. These systems can also enhance participation through interactive education, where AI tools encourage learners to think critically and delve deeply into subjects (Wang et al., 2024). In online settings devoid of traditional classroom dynamics, engagement becomes crucial. Personalization by AI tailors learning experiences to individual students by adjusting task difficulty and making resource recommendations based on individual performance. Moreover, AI-generated immediate feedback helps students identify and correct errors, strengthening their learning paths and enhancing retention (Escalante et al., 2023). Integrating various media forms—text, video, and interactive simulations—can cater to different learning styles and distribute the cognitive load more evenly. While incorporating AI in online learning offers significant benefits, challenges such as diverse educational needs and potential accessibility issues must be considered when designing AI-driven learning systems. Future developments in AI should aim to enhance cognitive load management, making learning more personalized and efficient.

AI Integration: AI systems can manage the cognitive load by presenting information that minimizes overload (e.g., by chunking content and using multimodal presentations).

Practical Example: An AI-assisted game-based learning platform breaks down complex science topics into manageable segments and uses multimedia elements to enhance understanding without overwhelming the learner (Chen & Chang, 2024).

Flow Theory

Mihaly Csikszentmihalyi's (2009) flow theory describes the state of complete immersion and satisfaction in activities that properly challenge one's abilities (Heutte et al., 2021). Often referred to as being "*in the zone*," this theory can be advantageously applied in the context of education, especially to create immersive and productive learning environments for online learning, enhanced by AI technologies such as ChatGPT (Shahzad et al., 2024). The theory posits that the state of flow is attained when there is a perfect equilibrium between the difficulty of a task and the individual's skill level, leading to maximum engagement and productivity. The key elements constituting flow include a deep, concentrated focus on the present moment, a merging of action and awareness where one's actions seem almost effortless, a loss of self-consciousness, a profound sense of personal control over the task at hand, an altered perception of time—either slowing down or speeding up—and experiencing the activity as intrinsically rewarding, often referred to as the autotelic experience. These elements enhance individual performance and provide a powerful framework for understanding how students engage and succeed in digital learning scenarios.

This theoretical approach helps educators and developers design instructional strategies that align well with learners' psychological needs and cognitive capacities.

Due to its intrinsic isolation and frequent interruptions, online learning presents unique challenges in achieving flow. However, integrating AI technologies can significantly enhance the capacity for flow by customizing learning experiences and reducing engagement barriers (Ikedinachi et al., 2019). AI can dynamically adjust the complexity of tasks based on the learner's performance to ensure that challenges are neither too simple nor too daunting. Quick feedback, essential for maintaining flow, can be provided by AI-enhanced platforms to allow learners make timely adjustments and sustain interest (Wang et al., 2024). Additionally, these tools can simulate a social learning environment through conversational exchanges that can increase students' sense of connectedness and immersion in the material (Zhai & Wibowo, 2023). Strategic implementations such as adaptive learning systems can track students' progress and adjust tasks accordingly. Gamification elements like badges, levels, and points can be personalized using AI to fit different learners' needs, potentially guiding them into flow states (Mustafa et al., 2022). Moreover, interactive and adaptive tools facilitate a responsive learning environment that encourages students to engage deeply with challenging content and explore new ideas dynamically. While applying flow theory to AI-driven education offers potential benefits, careful consideration is necessary to ensure that difficulty adjustments are appropriately aligned with the learner's evolving capabilities and that AI interactions remain engaging and natural.

AI Integration: AI can help maintain an optimal balance between challenge and skill level, keeping students in a state of flow and enhancing engagement and motivation.
Practical Example: An AI learning environment that implements automatic difficulty adaptation of tasks in real-time by profiling students based on their performance, ensuring they remain challenged but not frustrated (Chiu et al., 2023).

Technology Acceptance Model

The Technology Acceptance Model (TAM), introduced by Davis (1989), posits that two primary factors determine the acceptance and use of technology: perceived usefulness (PU) and perceived ease of use (PEOU). PU is defined as the degree to which a person believes that using a particular system would enhance their job performance, while PEOU refers to the extent to which a person believes that using the system would be free of effort (Mustafa & Garcia, 2021). AI in educational tools must adhere to the principles of TAM to maximize engagement. For instance, designing AI interfaces should prioritize user-friendliness and clearly demonstrate the technology's benefits. The interface must be intuitive, ensuring students can navigate and use the tool without extensive training or support. Additionally, the practical benefits of using ChatGPT, such as personalized feedback, immediate responses to queries, and adaptive learning paths, should be clearly communicated to students. This approach aligns with Venkatesh and Davis (2000), who expanded TAM by emphasizing that PU and PEOU significantly influence users' attitudes towards technology, thereby affecting their intention to use and actual usage behavior.

One of the advantages of AI is the ability to provide personalized learning experiences. AI algorithms can analyze students' interactions, identify their strengths and weaknesses, and tailor content to meet their needs. This personalization enhances PU by demonstrating that the technology can significantly improve learning outcomes. Crompton and Burke (2023) highlighted that AI-powered personalized learning significantly enhances student engagement and academic performance. By dynamically adapting content to match individual learning styles and pacing, AI ensures that students remain actively engaged and motivated throughout their learning journey. Immediate feedback is another critical component of effective learning that AI can provide. ChatGPT can offer instant responses to students' queries, helping them understand concepts and correct mistakes promptly. This immediate feedback loop enhances PU by showing that the tool can facilitate quicker learning and mastery of subjects. According to Boud and Molloy (2013), timely feedback is key to effective learning and can significantly enhance student engagement and motivation. With immediate feedback, students can continuously improve their understanding and performance. Additionally, ChatGPT can adapt learning paths based on learners' progress and performance. This adaptability ensures that students are neither bored with content that is too easy nor overwhelmed by content that is too difficult. By continuously adjusting the difficulty level and focus areas, AI tools maintain optimal learning conditions. The OECD Learning Compass 2030 outlines key objectives, including fostering students' agency and self-regulation skills, developing general competencies beyond subject-specific knowledge, and actively engaging learners' cognitive abilities. AI's ability to adapt learning experiences is a key strength, but achieving the envisioned personalized learning requires more than technological tools as it necessitates a balance between technology and human guidance.

AI Integration: Understanding factors that influence technology acceptance can help design AI tools that are more user-friendly and widely adopted.
Practical Example: An AI educational app incorporates user feedback to improve its interface, ensuring that users find it easy and effective to use (Kabudi et al., 2021).

Self-Determination Theory

Self-Determination Theory (SDT) provides an insightful framework for understanding student engagement in digital learning environments, particularly those utilizing AI technologies such as ChatGPT. Developed by Deci and Ryan, SDT emphasizes three critical psychological needs—autonomy, competence, and relatedness—which significantly influence motivation and engagement (Deci & Ryan, 2000). In the context of AI-enhanced learning (Bergdahl et al., 2023), autonomy is facilitated by the ability of these systems to adapt learning content to fit individual preferences and learning speeds, allowing learners to feel in control of their educational journeys. Competence is fostered through AI's ability to offer immediate and personalized feedback, helping learners to measure their progress and understand their capabilities effectively. This immediate feedback mechanism is crucial not only for skill development but also for reinforcing learners' belief in their ability to master new concepts. Lastly, relatedness—the feeling of connection to others—is supported by AI's capacity to simulate and facilitate social interactions and collaborations, creating a sense of community among remote learners.

Applying SDT to AI-driven online learning environments can significantly enhance the educational experience by closely aligning technology with human psychological needs. For autonomy, AI tools like ChatGPT customize the learning process by analyzing user data and preferences to present information in ways that best suit each learner's unique style, thereby enhancing their engagement and willingness to learn (Zawacki-Richter et al., 2019). Competence is continuously supported by the provision of tailored exercises and constructive feedback, which AI platforms can deliver in real time. This not only helps in addressing the immediate learning needs but also contributes to a cumulative build-up of skills and knowledge. Regarding relatedness, AI can play a pivotal role in fostering a sense of community and belonging through features that encourage collaboration and interaction, such as discussion forums moderated by intelligent agents or virtual group projects. These interactions are vital for maintaining motivation and emotional connection among students, particularly in settings that lack physical presence (Kovanović et al., 2015). Overall, by facilitating these three key aspects of SDT, AI-enhanced learning tools can significantly improve the effectiveness of online education, making learning more personalized, supportive, and engaging, which is essential for fostering intrinsic motivation and achieving higher academic success (Ryan & Deci, 2000; Xia et al., 2022).

AI Integration: AI can support autonomy, competence, and relatedness, which are key to intrinsic motivation according to self-determination theory.

Practical Example: An AI platform offers personalized learning paths, immediate feedback, and opportunities for social interaction, fostering a sense of autonomy, competence, and connection among learners (Bhutoria, 2022).

Cognitive Theory of Multimedia Learning

The Cognitive Theory of Multimedia Learning (CTML) provides a robust framework for understanding how students engage with and learn from multimedia content, which is increasingly relevant in AI-driven educational tools (AlShaikh et al., 2024). Grounded in key psychological theories such as CTL, dual-coding theory, and the multi-stage model of memory, CTML highlights the importance of using both verbal and visual information to foster deeper learning (Mayer, 2024). This theory is particularly applicable to AI environments where multimedia elements can be dynamically integrated based on the learner's interactions. According to CTML, meaningful learning occurs when learners are able to select relevant information, organize it into coherent cognitive structures, and integrate it with their existing knowledge base (Mayer, 2020). This process is enhanced in AI-enhanced learning platforms, which can tailor the presentation of multimedia content to match the learner's individual learning path, thus facilitating the critical cognitive processes of selection, organization, and integration.

Generative AI significantly enriches this personalized learning approach, aligning perfectly with the principles of CTML. It supports the immediate creation of customized learning content, addressing the need for timely information delivery, which is crucial for effective learning. Furthermore, interactions with AI agents introduce a dynamic social element into learning environments, enhancing the CTML's focus on meaningful learning by fostering a responsive and adaptive learning ecosystem. Such AI-powered environments are designed to effectively meet individual learning needs, creating highly personalized and dynamic educational experiences. These systems are adept at responding to immediate learning requirements and adapting to evolving educational needs and preferences, thereby ensuring a more personalized and effective learning journey. Incorporating generative AI into the principles of CTML shows a notable improvement in the quality and effectiveness of multimedia instructional messages. Offering greater customization and interactivity, generative AI facilitates deeper understanding and retention of knowledge for learners. Therefore, the integration of these AI technologies marks a significant advancement in applying CTML, promising to significantly enhance the effectiveness of multimedia learning and better align it with individual learners' needs.

AI Integration: AI can optimize multimedia learning by adapting knowledge presentations to individual learner's needs and preferences.

Practical Example: An e-learning platform adjusts the presentation style based on students' needs and preferences, such as using more visuals for visual learners or providing additional explanations for those who need more context (Sayed et al., 2023).

Feedback Intervention Theory

Feedback Intervention Theory (FIT) provides a valuable framework for analyzing how AI tools like ChatGPT deliver feedback and influence student engagement and performance. FIT emphasizes that feedback effectiveness is determined by its ability to shift the learner's focus towards standards or goals that are meaningful and aligned with their learning objectives (Kluger & DeNisi, 1996). According to FIT, feedback should ideally address discrepancies between current performances and desired outcomes, encouraging goal-oriented behaviors. In the context of AI-driven educational tools, this means designing interactions that inform learners of their progress and guide them in how to improve. For instance, when ChatGPT provides feedback, it can be programmed to highlight specific areas where a student's performance can be aligned more closely with the learning objectives (Ibrahim et al., 2023). Moreover, FIT underscores the importance of directing feedback to a hierarchy level within the learner's goal structure that maximizes engagement and effectiveness. For example, while some students may benefit from feedback to enhance task-specific skills, others might require encouragement that fosters motivation or adjusts meta-cognitive strategies (Chen et al., 2023; Yadav et al., 2023). By integrating these insights, AI tools like ChatGPT can deliver personalized feedback that resonates with individual learners' needs, enhancing engagement and the quality of learning.

Furthermore, the application of FIT in AI environments can be particularly sophisticated due to the ability of AI to process and synthesize large amounts of data rapidly. AI tools can dynamically adapt feedback based on the learner's ongoing performance (Bhutoria, 2022). It can perform personalization to address individual needs at various levels of the feedback hierarchy—from task execution to the motivational aspects and meta-cognitive reflections. This adaptive feedback mechanism supports learners in maintaining or adjusting their efforts toward learning goals, depending on the feedback's nature and the learners' responses to it. For example, AI-driven systems can modify the difficulty of tasks if the learner is performing well or provide additional resources when a learner is struggling. By continuously adapting to the learner's needs, AI tools can help maintain an optimal level of challenge and engagement, encouraging persistence and deeper engagement with the content. This dynamic interaction not only supports immediate learning needs but also fosters a long-term educational relationship where feedback is not just a corrective tool but a means of ongoing, personalized support that enhances learning outcomes.

AI Integration: AI provides timely and specific feedback to guide learning, foster a deeper understanding of the subject matter, and improve performance.
Practical Example: An AI tool gives instant feedback on student writing, highlighting areas of improvement and suggesting ways to enhance coherence (Escalante et al., 2023).

INTEGRATING AI AND THEORIES INTO PRACTICE

As AI-enhanced learning continues to evolve, it is crucial to consider the implications of this shifting field and anticipate more groundbreaking educational applications. This chapter explores several theoretical frameworks to examine AI as an instructional tool. While countless theories illuminate student engagement, personalized learning, flexibility, and accessibility in online learning, this chapter examined eight fundamental learning theories. These theories offer valuable insights into the intricate dynamics of student engagement, learning processes, and the impact of digital environments on education. By synthesizing insights from these diverse theoretical frameworks, this chapter informs pedagogical practices, shapes educational policies, and paves the way for future research in AI-enhanced learning. The chosen theoretical frameworks emphasize the significance of social interaction and collaborative learning in knowledge construction regardless of whether students are in the same room or learning together from a distance. Instructors who leverage AI-driven learning environments can facilitate collaborative interactions among students, instructors, and even AI-driven virtual tutors. This collaboration fosters the necessary dialogue, peer feedback, and collective knowledge creation in the online educational experience. Through collaborative learning activities such as group discussions, virtual projects, and shared problem-solving tasks, students co-construct knowledge, challenge perspectives, and negotiate meaning within a supportive learning community.

AI-enhanced learning thus emerges as vibrant centers of exploration, discovery, and knowledge generation. Through active engagement, reflective practice, and social interaction, students acquire new knowledge and skills and cultivate critical thinking, problem-solving, and communication abilities crucial for success in the digital era. As we explore deeper into the dynamics of student engagement within these multifaceted learning environments, this chapter unraveled the intricate relationships between established theoretical frameworks and AI-driven educational technologies, with a particular focus on ChatGPT. Integrating AI with educational theories extends beyond mere automation of tasks; it transforms the learning environment into an adaptive, responsive, and engaging space. AI systems can personalize learning experiences by dynamically adjusting content and feedback based on individual student needs.

This adaptability ensures that students receive the appropriate level of challenge and support, promoting sustained engagement and deeper learning. Furthermore, AI can facilitate continuous and formative assessment, providing real-time insights into student progress and identifying areas where additional support may be needed. This immediate feedback loop helps students to reflect on their learning journey, encouraging self-regulation and autonomy. Educators, too, benefit from AI-generated analytics, which offers a granular view of classroom dynamics and student performance, enabling data-driven decision-making to enhance instructional strategies.

While AI in education offers transformative potential, it also brings critical challenges that warrant careful consideration and proactive management (Garcia et al., 2025). One significant concern is student privacy. AI systems collect extensive data on students' activities, learning patterns, and even personal information, which raises substantial risks around data security and privacy. Mismanagement of this data could lead to breaches that compromise students' identities and expose them to potential misuse of their information. Furthermore, AI algorithms often carry inherent biases embedded during development (Alvarez et al., 2024). These biases can lead to discriminatory practices, reinforce stereotypes, or marginalize certain student groups, especially those from underrepresented or vulnerable communities. Additionally, over-reliance on AI may risk diminishing the human elements that are vital in education. AI lacks the ability to provide the emotional intelligence, empathy, and personalized encouragement that skilled educators offer. This mechanization could depersonalize education, potentially leading to a reduction in critical thinking, creativity, and the human connections that support a holistic learning experience (Garcia, 2024; Karan & Angadi, 2023). In some cases, the corporatization of AI in education introduces an additional layer of complexity. As private companies increasingly provide AI-driven educational tools, there is a risk that commercial motives may overshadow educational goals. This scenario can result in the commodification of student data, where personal information is leveraged for profit rather than used solely to enhance educational outcomes. Such practices can erode trust and shift the focus away from students' well-being and academic growth.

In light of these substantial risks, it is imperative to implement robust policies that guide the ethical integration of AI in education (Fu & Weng, 2024; Garcia, Garcia, et al., 2024). Policymakers, educational institutions, and AI developers must work together to establish clear, enforceable regulations that prioritize data privacy, equity, transparency, and inclusivity. Data privacy laws specific to educational contexts should be strengthened to protect students' personal information rigorously. These policies must not only regulate how data is collected and used but also include transparent communication with students and parents about what data is collected, how it will be utilized, and the measures taken to secure it. Equally critical is the need for policies that mandate ongoing oversight and regular audits of AI algorithms to prevent and address potential biases. Without stringent auditing and accountability, AI systems risk perpetuating historical inequities, embedding discriminatory practices, and systematically disadvantaging marginalized groups. Accessibility policies are also essential to bridge the digital divide. To prevent exacerbating inequalities, policies should incentivize the development of low-bandwidth, low-cost AI tools that are functional on basic devices and accessible to students in low-resource areas. Furthermore, funding initiatives that support infrastructure development in underserved communities are critical to ensuring equitable access to AI-enhanced learning.

Finally, policymakers and educational leaders must champion a balanced approach to AI in education, particularly in online learning environments where student engagement is a critical factor for success. AI should be designed to complement, not replace, the human elements that are integral to effective teaching and fostering meaningful engagement. Policies must advocate for the responsible use of AI, encouraging institutions to leverage technology as a supportive tool that enhances student interaction, motivation, and engagement with the content—rather than as a substitute for human educators. This balanced approach is essential to ensure that AI amplifies the educational experience, preserving the essential human connections, empathy, and mentorship that deeply engage students and support their learning journey. Through proactive, comprehensive policy measures, stakeholders can harness the potential of AI technologies in ways that foster enriched, interactive, and inclusive online learning environments. Such policy-driven commitment is essential to guide the ethical and effective future of AI in education, ensuring it remains a tool that promotes engaged learning experiences for all students.

CONCLUSION

Online education has revolutionized the way knowledge is delivered and received. Student engagement is central to the success of this mode, which significantly impacts learning outcomes and retention rates. This chapter signifies the potential of theoretical frameworks to guide researchers in exploring student engagement in AI-enhanced online learning environments. Examining these frameworks provides a structured lens through which researchers, educators, and policymakers can approach the complex interplay between AI technology and student engagement. Researchers can utilize these frameworks to explore deeper into optimizing AI applications that can generate insights on how to make AI a responsible and effective tool for enhancing engagement. Educators can apply these findings to design more interactive and personalized teaching strategies, increasing student motivation, participation, and success in online learning. Policymakers, in turn, can leverage these insights to create supportive environments for innovative educational technologies, emphasizing ethical integration and equitable access to ensure AI benefits all learners. Such a review is essential for shaping future research, informing educational policy, and guiding practical applications in the field. As we continue to investigate and refine the use of AI in education, it is essential to address challenges such as ethics, privacy, bias, and the digital divide. By working together across research, practice, and policy, we can ensure that online learning remains a dynamic, inclusive, and effective mode of instruction. This combined approach not only sustains student engagement but also equips learners with the skills to thrive in an increasingly digital world.

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KEY TERMS AND DEFINITIONS

Artificial Intelligence: It refers to the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning (acquiring information and rules for using the information), reasoning (using the rules to reach approximate or definite conclusions), and self-correction.

Educational Technology: It refers to using technology tools and digital resources to facilitate and enhance the teaching and learning process. This includes a wide range of software, hardware, and processes that support educational practices and improve learning effectiveness and efficiency.

Generative AI: It refers to artificial intelligence systems that can generate new content, such as text, images, or music, based on the data they have been trained on. These systems use complex algorithms and neural networks to create outputs that mimic human creativity and can be used in various fields, including education, entertainment, and art.

Online Learning: A method of delivering educational content and instruction via the internet. It allows students to access learning materials, participate in virtual classrooms, and interact with instructors and peers remotely. Online learning can be synchronous (real-time) or asynchronous (self-paced), providing flexibility and accessibility to learners.

Student Engagement: It refers to the level of interest, participation, and enthusiasm that students show in the learning process. It encompasses emotional, behavioral, and cognitive aspects, influencing how students interact with the content, instructors, and their peers. High levels of engagement are associated with better academic performance, retention, and overall learning outcomes.

Theoretical Frameworks: Structured sets of concepts and theories that provide a foundation for research and practice. In education, theoretical frameworks guide the understanding of learning processes, student behavior, and instructional strategies. They help in designing, analyzing, and interpreting educational practices and outcomes.