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Ali Rashed Ibraheam Almohesh

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Résumé de l'article

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AI Application (ChatGPT) and Saudi Arabian Primary School Students' Autonomy in Online Classes: Exploring Students and Teachers' Perceptions

Dr. Ali Rashed Ibraheam Almohesh
Department of Arabic Language, College of Education in Al-Kharj, Prince Sattam Bin Abdulaziz University, Al-Kharj, Saudi Arabia

Abstract

In education, the integration of artificial intelligence (AI) has presented opportunities to transform the dynamics of online learning. This study investigated the impact of an AI-powered application, namely ChatGPT, on the autonomy of Saudi Arabian primary students participating in online classes. It also explored how the implementation of Chat GPT influenced Saudi Arabian primary students' autonomy. In this mixed-methods study, a quasi-experimental design assessed the impact of ChatGPT on learner autonomy among 250 Saudi Arabian primary students from six primary schools in Riyadh, Saudi Arabia. The quantitative analysis employed descriptive statistics and t-tests, while the qualitative data underwent interpretative phenomenological analysis. To ensure coding reliability, 20% of the codes were independently reviewed by an external coder, with a 94% inter-coder agreement coefficient reached through consensus. Findings revealed that ChatGPT significantly affected the participants' perceptions of autonomy and its different dimensions. Qualitative data showed that AI-powered applications contributed to the students' autonomy in 10 different ways. Participants also mentioned that AI-powered apps might have some negative consequences. This study has theoretical implications for redefining learner autonomy in the digital age and calls for the exploration of many facets of autonomy. Practical applications from this study include strategic integration of AI into online education, data security, and the need for orientation programs.

Keywords: AI-powered applications, ChatGPT, students' autonomy, online classes, students' perceptions

AI Application (ChatGPT) and Saudi Arabian Primary School Students' Autonomy in Online Classes: Exploring Students and Teachers' Perceptions

The use of artificial intelligence (AI) in education is having a significant impact on online learning in Saudi Arabia, influencing personalized learning, automating tasks for educators, and providing insights into student performance (Khan et al., 2022; Popenici & Kerr, 2017; Seo et al., 2021). AI tutoring systems such as those developed by Hwang et al. (2020) were examined. Roll et al. (2018) and VanLehn (2011) aimed to provide personalized advice and support by adapting content to students' individual learning patterns. AI teaching assistants have simplified educators' tasks by addressing routine questions from students in online forums. Meanwhile, AI analytics have provided insights into student performance through clickstream data analysis (Chaudhry et al., 2023; Holstein et al., 2018; Pradana et al., 2023).

Despite the potential benefits of AI in education, concerns may arise among students and teachers in Saudi Arabia. Students may perceive the collection and analysis of their data by AI systems as an invasion of privacy, reminiscent of incidents such as the Facebook-Cambridge Analytica data scandal. Concerns about data or algorithmic bias from AI agents have been viewed as discriminatory (Murphy, 2019; Rudolph et al., 2023). Educators have expressed concerns that an over-reliance on AI could impact students' ability to learn independently, think critically, and solve problems creatively (Wogu et al., 2018). Therefore, it is crucial to examine students' and teachers' perceptions of the impact of AI on online learning in the Saudi Arabian context (Seo et al., 2021).

Within the AI in Education (AIEd) community, there has been an active effort to explore the role of AI systems in shaping online education, extending beyond traditional educational settings (Roll & Wylie, 2016). A systematic review of AIEd literature from 2007 to 2018 highlighted a significant gap, emphasizing the need for more rigorous examination and contemplation of the ethical ramifications associated with AI systems in the dynamic space of learner-instructor interactions (Zawacki-Richter et al., 2019). Popenici and Kerr (2017) focused on the broader impact of AI on the learning and teaching landscape and revealed potential conflicts such as privacy concerns, shifts in power dynamics, and issues of excessive control. These findings have underscored the urgency for continued research efforts aimed at identifying existing gaps, unresolved issues, or potential barriers to the full transformative potential of AI systems within educational contexts.

ChatGPT has gained attention for its ability to provide detailed written responses based on extensive databases, but there have been concerns about its factual accuracy (Ray, 2023). A pilot study using ChatGPT for academic papers found that the AI chatbot produced coherent and informative content, suggesting a potential focus on enhancing students' creativity and critical thinking in education (Zhai, 2022). Thoughtfully used, ChatGPT could offer language teachers an opportunity to enrich language instruction and create engaging language learning experiences for their students.

In contemporary language education, learner autonomy has assumed a pivotal role, especially in the era of digital advancements. Autonomous learners have proactively shouldered the responsibility for their educational goals, exercising informed choices regarding what, how, and when to learn, all while

proficiently managing their learning processes within online environments (Benson, 2007; Kang & Im, 2013). This autonomy has not only allowed students to discern their strengths and weaknesses but also facilitated the adaptation of learning strategies and active engagement in the learning process. Furthermore, it has endowed students with indispensable lifelong learning skills, fostering independence in managing their time and pursuing knowledge.

Research on AI systems in online education has highlighted a gap in understanding how both students and instructors perceive and interact with these technologies (Wogu et al., 2018). A comprehensive understanding of learner perceptions and experiences is crucial for the ethical and effective implementation of AI systems in online education. Therefore, research into learner perceptions and experiences can inform strategies that harness the potential of AI while addressing privacy concerns and preserving learner autonomy (Kang & Im, 2013).

In the context of Saudi Arabia, the use of artificial intelligence (AI) in education has witnessed a surge, impacting various facets of online learning. The implementation of AI systems holds the promise of personalized learning experiences, task automation for educators, and valuable insights into student performance. However, within this landscape, there is a critical need to understand how these AI applications are perceived by both students and instructors in the Saudi Arabian educational setting. Given the cultural nuances and specificities of the Saudi Arabian context, such research becomes imperative to ensure that the integration of AI aligns with the local educational ethos and addresses any unique concerns that may arise.

The rationale for this study was based on the potential gaps and unexplored territories within the Saudi Arabian educational framework concerning AI in online learning. While there is growing enthusiasm about the benefits of AI, including its potential to enhance personalized learning and streamline educational tasks, there has been limited research on how individuals within the Saudi Arabian educational system perceive and interact with these technologies. Moreover, the cultural and contextual factors specific to Saudi Arabia may introduce distinctive dynamics in the learner-instructor relationship when AI is introduced. This study aimed to bridge this gap by delving into the perceptions, concerns, and experiences of students and instructors, offering insights that can inform the ethical and effective implementation of AI in online education within the Saudi Arabian context. Understanding these nuances is pivotal for ensuring that AI systems align with the cultural values, privacy expectations, and educational goals unique to Saudi Arabia, ultimately fostering an environment where AI complements and enhances the learning experience without compromising learner autonomy. This study investigated the effects of an AI-powered application, ChatGPT, on Saudi Arabian primary school students' autonomy in online classes. It also explored students' and teachers' perceptions of the AI-powered application. The study was framed by the following research questions:

1. Do AI-powered applications (e.g., ChatGPT) have significant impact on Saudi Arabian primary school students' autonomy in online classes?

2. What are the Saudi Arabian students and teachers' perceptions of using AI-powered applications in online classes?

Literature Review

The development of chatbots, starting with Weizenbaum's ELIZA in the 1960s and progressing through entities such as ALICE, Cleverbot, and integration into messaging apps such as Facebook Messenger, has been marked by advances in mimicking human-like appearances, as highlighted by Ayedoun et al. (2019) and Huang et al. (2018). Modern chatbots have used sophisticated techniques such as natural language processing and neural machine translation (Smutny & Schreiberova, 2020). There has been a growing trend to integrate chatbots into second and foreign language learning (L2 and FL), which has attracted the attention of researchers such as Wang et al. (2021). Huang et al. (2017) studied GenieTutor and the Mondly chatbot, and highlighted their significant role in English as a foreign language (EFL) learning contexts, as they provided a range of benefits and transformed the learning experience for students.

GenieTutor, developed by Huang et al. (2017) represented a significant advance in the application of chatbots in language learning. It provided students with an interactive and personalized learning environment characterized by features such as unlimited patience, instant responses, and a tailored focus on specific topics. Similarly, the Mondly chatbot illustrated the effectiveness of chatbots in EFL learning. Its unique capabilities helped reduce learner anxiety and promoted a supportive learning atmosphere. The benefits that chatbots have brought to language learning go beyond mere convenience. Fryer et al. (2020) highlighted how unlimited patience was a crucial aspect of these AI-controlled language companions. In traditional learning environments, human teachers may be limited by time and resources, making it difficult to respond to the individual pace of each student. However, chatbots have overcome this limitation by offering learners the luxury of unlimited patience. This has not only allowed students to grasp concepts at their own pace, but also ensured a personalized learning experience that adapts to their individual needs.

Additionally, the use of chatbots helped reduce learner anxiety. Fryer et al. (2020) emphasized how the absence of human intervention in the learning process can create a stress-free environment for students. Traditional language learning environments can be anxiety-inducing, especially for beginners who are wary of making mistakes. Non-judgmental and consistently supportive, chatbots have created a more relaxed and enjoyable atmosphere and encouraged learners to take risks, experiment with language, and ultimately improve their language skills. AI systems have played a crucial role in shaping the learning environment. Various AI systems have offered diverse possible uses. For example, AI teaching assistants have improved communication (Rusmiyanto et al., 2023) and AI assessment systems (Perin & Lauterbach, 2018) have optimized grade communication. Integrating AI into online education has also included continuous feedback systems (Luckin, 2017), virtual avatars for collaboration (Heidicker et al., 2017), and AI facial analytics (Aslan et al., 2019) to improve teacher presence and thus strengthen technology-enhanced learning environments.

Despite its positive impact, the integration of commercial AI systems such as Proctorio for proctoring during exams has introduced complexities in the interaction between learners and teachers, raising concerns about test anxiety (Bajaj & Li, 2020). Similarly, the application of Squirrel AI aimed at adaptive learning has raised concerns that it could potentially limit students' creative learning processes (Beard, 2020). Research has suggested positive effects of chatbots on critical thinking skills, as well as effectiveness, especially in speaking tasks (El Shazly, 2021; Kooli, 2023). However, concerns have been raised about novelty effects in language learning (Fryer et al., 2017), along with criticism of mechanical behavior and the

lack of essential communication components (Smutny & Schreiberova, 2020). In particular, empirical studies on the influence of chatbots on L2 and FL learning are still incomplete (Kooli, 2023). Smutny and Schreiberova (2020) proposed research to provide guidelines for integrating chatbots into teaching methods and analyze interactions between learners and chatbots.

Learner Autonomy in Online Education

Learner autonomy in education refers to a student's capacity to take responsibility for their learning and actively engage in the learning environment. This includes (a) making decisions, (b) setting goals, (c) monitoring progress, (d) self-assessment, (e) choosing effective learning strategies, (f) collaborating with others, (g) seeking guidance from peers and educators, and (h) reflecting on learning experiences. The concept encompasses both cognitive elements like awareness, perception, motivation, and reflection, as well as behavioral aspects, including specific learning actions and strategies (Benson, 2007).

The digital age has introduced new opportunities for learner autonomy in education. Online learning environments have provided students with the ability to manage their learning independently, offering flexibility in setting schedules, organizing resources, and taking charge of their educational journey (Dang, 2010, 2012). Learner autonomy, vital in online learning, has promoted active learning and preparing students for lifelong, self-directed learning beyond the classroom (Davis et al., 2019). With the support of technology, students have had unprecedented access to self-study, synchronous and asynchronous interaction with instructors, and collaborative learning experiences (Hutapea, 2019; Tran & Duong, 2020).

Online learning modes, including synchronous and asynchronous learning, offer varying levels of direct interaction with instructors and peers. Asynchronous learning, facilitated through platforms like Moodle, e-mail, and discussion forums, has allowed students to access educational resources at their convenience, promoting self-regulation and self-motivation (Zhong, 2018). In contrast, synchronous learning through videoconferencing tools like Zoom or Google Meet has enabled real-time interaction despite geographical distances, further enhancing learner autonomy (Dashtestani, 2020).

To promote learner autonomy in online education, teachers play a crucial role. Autonomy is not a fixed state, but an ongoing process that students achieve through specific conditions (Benson, 2007). Educators should provide guidance and scaffolding to facilitate students' development of autonomy in online learning (Lai, 2019). This has included teaching students self-regulation strategies, promoting motivation and engagement, emphasizing active learning, promoting metacognition through self-assessment, and encouraging self-directed learning (Almusharraf, 2020). Peer assessment, collaborative group work, and knowledge sharing opportunities also contribute to learners' autonomous decision-making and problem-solving (Lai, 2019). Overall, learner autonomy in online education has leveraged technology and educational strategies to empower students to take ownership of their learning, manage their time effectively, and develop the skills necessary for lifelong self-directed learning and successful collaboration (Borg & Alshumaimeri, 2019). Online learning environments have provided students with multiple opportunities to become autonomous, self-regulated, and confident learners who are able to make informed decisions and actively participate in their educational journeys.

Methodology

Sample and Procedure

In line with the research objectives, we used a mixed-methods research design. For the quantitative phase, we used a quasi-experimental research design (i.e., pretest/posttest, control and experimental groups) to assess the effect of ChatGPT on students' learner autonomy and its different aspects. However, for the qualitative phase, we employed a qualitative phenomenological research method to delve deeply into the lived experiences of the Grade 6 Saudi Arabian primary students' use of AI-powered applications such as ChatGPT. To ensure control for external variables such as large differences and teacher effects, we selected six intact, sixth grade classes from six primary schools in Riadh province, Saudi Arabia. Three intact classes consisting of 75 students in total were assigned to the experimental group, and three classes consisting of 75 students in total were assigned to the experimental group. The students in the experimental group were invited to a two-hour workshop on the Chat GBT application, and they were taught how it might be useful in education, while the control group received instruction through conventional teaching methods, based on the education system of the country. The participants for the qualitative phase were 14 students and five primary school teachers who were engaged with AI-empowered technology (ChatGPT) in teaching and learning.

A learner autonomy questionnaire developed by Little (1996) was employed for data collection. This questionnaire consisted of a five-point Likert scale, ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*), and was designed to address our first research question, which aimed to evaluate students' levels of learner autonomy. The questionnaire items were categorized into five domains: (a) self-direction (eight items); (b) self-instruction (four items); (c) self-access (three items); (d) motivation (seven items); and (e) collaboration (six items). The questionnaire was translated to Arabic. The reliability of the instrument was estimated using Cronbach's alpha, and the results showed that the internal consistency of the questionnaire and its dimensions exceeded 0.83. Furthermore, an interview checklist consisting of 10 open-ended questions followed by prompts was used to explore the participant's perceptions, feelings, and cognitions of the advantages and challenges of using AI-powered apps such as ChatGPT. The interview content was confirmed by three university professors interested in educational studies.

After completing 10 teaching units, all six classes were asked to fill out the learning autonomy questionnaire to assess the impact of teaching methods and AI applications on learner autonomy. Thirty students from Group A, which used AI applications, were then interviewed individually to gain deeper insights into their experiences. It is noteworthy that after the survey of the 14th student, data saturation was reached, which indicated that no further important information was to be expected.

Data Analysis

The quantitative data in this study were analyzed using descriptive statistics and independent sample *t*-tests. At the same time, the qualitative data was subjected to a multi-stage process. First, the qualitative data were transcribed and then an interpretative phenomenological analysis (IPA) was carried out. The IPA involved several phases, including immersion in the text, identifying themes, grouping themes, exploring interrelationships, and summarizing with supporting examples. To facilitate the coding, categorization, and topic development processes, the MAXQDA 2022 software was used. Using a thematic approach, codes,

categories, and themes were extracted directly from the qualitative data. To increase the reliability of the coding process, 20% of the codes ($n = 24$) were independently checked by an external coder with experience in thematic analysis. During this independent review, disagreements between the primary coder and external coder occurred twice, resulting in an intercoder agreement coefficient of 94%. To resolve these discrepancies, a common consensus was reached through discussion and mutual agreement. The aim of this rigorous process was to ensure the accuracy and consistency of the qualitative data analysis in this study.

Results

Impact of AI on Students' Autonomy

Table 1 summarizes data comparing the intact classes' scores on different dimensions of learner autonomy before the treatment.

Table 1

Control and Experimental Group Scores on Learner Autonomy Pretest

Group	Collaboration		Motivation		Self-access		Self-instruction		Self-direction		*t*	*df*	*p*
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	0.89	248	0.62
Control	3.2	0.85	3.3	0.83	2.90	0.79	2.65	0.67	3.1	0.56			
Experimental	3.3	0.79	3.26	0.91	2.83	0.82	2.70	0.83	3.20	0.67			

As indicated in Table 1, no statistically significant differences were observed between the control group concerning collaboration. Likewise, there were no significant differences between the control group and the experimental group regarding motivation. Similarly, no statistically significant differences were found between the control group and the experimental group in terms of self-access. Additionally, there were no significant distinctions between the control group and the experimental group concerning self-instruction. Finally, the results indicated no significant difference between the control group and the experimental group in mean scores on self-direction. Consequently, the two groups demonstrated homogeneity at the commencement of the study. To assess whether AI-powered applications contributed to students' autonomy, *t*-tests were conducted on the groups' posttest scores, and the results are presented in Table 2.

Table 2

Control and Experimental Group Scores on Learner Autonomy Posttest

Group	Collaboration		Motivation		Self-access		Self-instruction		Self-direction		t	df	p
	M	SD	M	SD	M	SD	M	SD	M	SD	0.89	248	< 0.001
Control	3.4	0.83	3.29	0.87	3.1	0.80	2.71	0.83	3.23	0.72	12.23	248	
Experimental	4.11	1.1	4.21	0.84	4.2	0.83	3.92	1.1	4.21	0.89			

As depicted in Table 2, there were notable and statistically significant differences between the control group and the experimental group (in terms of collaboration, motivation, self-access, self-instruction and self-direction. Consequently, the two groups exhibited divergent perceptions of learner autonomy at the conclusion of the treatment, highlighting the positive contribution of AI-powered applications to students' autonomy.

Students' and Teachers' Perceptions

The interviews with 14 students and five teachers were transcribed, and 35 open themes were extracted, which were reduced to 10 central themes. Each central theme, along with its constituents, has been explained and exemplified in the following sections.

Autonomy in Learning

The first extracted theme consisted of self-directed learning, independence, and control over learning. This theme reflected students' appreciation for the ability to shape their learning experiences independently, allowing them to set their own pace and explore topics of personal interest. For example, Student 1 emphasized the significance of AI tools in providing autonomy, noting that "these AI tools give me the autonomy to learn at my own pace and explore topics of interest." Teacher 2 echoed a similar sentiment, stating "students feel more in control of their learning journey; they can decide what and when to study." This finding underscored the common perspective among students regarding the autonomy that AI-powered applications offer in their educational journeys.

Personalized Learning

The second central theme encompassed tailored content, adaptive feedback, and individual progress. Students appreciated AI's ability to cater to their specific learning needs. For instance, Student 9 highlighted the personalized nature of AI applications, noting that they "adapt to my level, offering a personalized learning experience." Teacher 1 reinforced this view, stating "the feedback the students get from these apps is specific to their needs, which enhances their learning." This demonstrated the consensus among students on the value of personalized learning experiences facilitated by AI-powered applications.

Time Management

The third central theme encompassed efficient use of time, flexibility, and scheduling. Students found AI tools helpful in optimizing their study schedules. For example, Student 4 highlighted the efficiency of AI

tools. "Using AI tools helps me manage my study time more efficiently, and I can learn when it suits me." Student 6 echoed this sentiment, saying, "I appreciate the flexibility to study anytime, especially when I have a busy schedule" (S6). This reflects the consensus among students on the positive impact of AI-powered applications on time management in their learning journeys.

Motivation

The fourth central theme comprised engagement, gamification, and progress tracking. Students derived motivation from AI applications, including gamified elements and progress monitoring. For instance, Student 6 noted the impact of gamification. "The gamified elements in these apps make learning fun and keep me motivated." Teacher 3 also added that "seeing the students' progress and achievements motivates them to continue using these tools." These testimonies underscored the role of AI-powered applications in maintaining student motivation and engagement.

Learning Enhancement

The fifth central theme included complementing traditional education, skill development, and deeper understanding. Students found AI applications augmented their classroom learning and deepen their understanding of subjects. For instance, Student 12 expressed how AI applications complemented their learning. "These AI applications complement my classroom learning and help me grasp concepts more deeply." Teacher 2 also highlighted the benefit of these tools, saying that "I've developed language skills faster using these tools alongside my classes" (Teacher 2). These accounts underscored the role of AI-powered applications in enhancing and reinforcing students' educational experiences.

Autonomy Versus Guidance

The sixth central theme dealt with balancing autonomy with the need for human guidance. Students valued the independence AI offered but also recognized the importance of human interaction. Student 7 emphasized the need for occasional guidance. "While I value autonomy, sometimes I wish for human guidance to clarify doubts." Student 11 shared their approach to striking a balance. "I find a balance by using AI tools for self-paced learning and consulting teachers when needed." These perspectives highlighted the importance of harmonizing autonomous learning with human support when necessary.

Data Privacy and Ethics

The seventh central theme encompassed data security concerns, ethical implications, and privacy awareness. Students expressed concerns about how their data was used and were mindful of the ethical aspects of AI in education. Student 4 voiced concerns about data use. "I'm concerned about how my data is used, and I want to ensure my privacy while using AI apps." Teacher 3 also emphasized the importance of ethical awareness. "The ethical implications of AI in education are important; I want to be aware of these issues." The findings within this theme underscored students' vigilance regarding data privacy and ethical considerations in AI-powered educational tools.

Skill Transferability

The eighth central theme involved the applicability of knowledge and skills gained from AI apps to real-life situations. Students pondered the practical value of the skills they acquired. For example, Student 14

expressed curiosity about skill applicability. "I wonder if the skills I gain from these apps will be useful in real-life situations." Similarly, Teacher 5 articulated hopes for skill application. "I hope the students can apply the knowledge and skills acquired from AI apps to their future career." These viewpoints highlighted participants' considerations regarding the real-world utility of skills acquired through AI applications.

Technological Dependence

The ninth central theme encompassed concerns about reliance on AI, potential reductions in critical thinking, and overreliance on technology. Students expressed apprehensions about becoming overly dependent on AI. For instance, Student 12 said "I worry that I might become too dependent on AI and lose my critical thinking skills." Student 3 also stated that "I'm cautious not to rely solely on AI; I still want to think critically and solve problems." Similarly, Teacher 2 noted that if students were highly dependent on the use of technology they might not think critically. These perspectives highlighted awareness of the need to balance technology use with critical thinking and problem-solving skills.

Educational Access

The final central theme was concerned with the potential for AI tools to enhance educational access for diverse learners and address learning barriers. Participants recognized the value of AI in promoting inclusivity. For example, Teacher 3 highlighted the potential of AI tools noting that they "can make education more accessible for people with different learning needs." Teacher 1 expressed appreciation for the inclusivity AI offers and that "it can bridge educational gaps and empower more learners." These insights underscored the positive impact of AI in fostering educational inclusivity and accessibility.

Discussion

In the digital age, the integration of AI into online education has revolutionized the way students and instructors interact. AI-powered applications have enhanced various aspects of the online learning experience, from streamlining communication between instructors and students to providing personalized learning content and continuous feedback. In this study, we delved into the intricate relationship between AI-powered applications and learner autonomy in the online education context, with a specific focus on collaboration, motivation, self-access, self-instruction, and self-direction.

The quantitative data revealed noteworthy disparities in autonomy between the control group and the experimental group who were exposed to AI-powered applications. These differences manifested across multiple dimensions, including collaboration, motivation, self-access, self-instruction, and self-direction. The experimental group, enriched with the use of AI-powered applications, exhibited significantly higher levels of learner autonomy in each of these domains. This indicated a positive contribution of AI technology to enhancing learner autonomy within online education.

To comprehensively understand and substantiate these findings, it is crucial to contextualize them within the broader landscape of existing research on the intersection of AI and online education, particularly as it relates to learner autonomy. A multitude of studies have illustrated the positive impact of AI systems on diverse facets of online education, from facilitating communication between instructors and students to

delivering personalized learning experiences and feedback mechanisms. Goel and Polepeddi (2018) autonomously responded to student introductions, posted weekly announcements, and addressed routine queries, effectively enhancing collaboration within the online learning environment. Furthermore, the work of Ross et al. (2018) offered insight into online adaptive quizzes that provided personalized learning content tailored to each student's specific needs. This personalization not only motivated students but also fostered a deeper sense of engagement, aligning with the findings on motivation in our study. Heidegger et al. (2017) explored the innovative use of virtual avatars in immersive virtual environments to facilitate collaboration among physically separated users. These avatars significantly contributed to a heightened sense of presence and effective collaboration, aligning with our findings on collaboration.

Additionally, Aslan et al. (2019) devised AI facial analytics to enhance instructors' presence as coaches in technology-mediated learning environments, thereby boosting self-direction and autonomy. Moreover, Luckin (2017) demonstrated AI systems that provided continuous feedback on students' learning processes and their progress toward learning goals. This continuous feedback mechanism was instrumental in motivating students and guiding their self-instruction, in line with our study's findings. Furthermore, Tran and Duong (2020) emphasized the importance of learner autonomy in online education, with the support of technology, offering unprecedented access to self-study, asynchronous and synchronous interaction with instructors, and collaborative learning experiences. Their work aligns with our focus on autonomy in online education.

Finally, Richardson et al. (2020) highlighted the role of instructors in promoting learner autonomy in online learning, emphasizing the importance of self-regulation strategies, motivation, engagement, metacognition, and self-directed learning. Their findings were consistent with our study's emphasis on the significance of autonomy in online education and the role of instructors in fostering it. However, it is important to acknowledge that not all studies aligned with our findings. Bergmans et al. (2021) discussed the implementation of Proctorio, a system designed to prevent cheating by monitoring students during exams and raised concerns about test-taking anxiety and potential challenges in collaboration. Similarly, Beard (2020) highlighted concerns regarding the potential restriction of creative learning in the context of Squirrel AI, suggesting potential issues with motivation.

These variations underscored the importance of considering the specific context, implementation, and characteristics of AI-powered applications, as these factors can influence outcomes. Moreover, they emphasized the need for further research to gain a more nuanced understanding of the relationship between AI technology and learner autonomy. In conclusion, our findings shed light on the substantial impact of AI-powered applications on learner autonomy within the online education landscape. By examining the contributions of AI technology to collaboration, motivation, self-access, self-instruction, and self-direction, we have gained valuable insights into the complex dynamics of online education. While existing research provides a strong foundation, it is crucial to delve deeper into the unique features and functionalities of AI systems to maximize their potential to enhance learner autonomy, ultimately enriching the online learning experience for students and educators.

Implications

The study has several theoretical implications. First, it contributes to the growing literature on the integration of artificial intelligence into educational environments and illuminates its impact on student autonomy—a crucial aspect of effective learning. The findings have expanded our understanding of the nuanced dynamics among technology, pedagogy, and student responsibility in the unique context of Saudi primary education. Additionally, the study can inform educators, policymakers, and curriculum designers about the potential benefits and challenges associated with AI applications in promoting student autonomy, thereby guiding the development of future educational strategies and interventions. Furthermore, examining students' and teachers' perceptions provides a comprehensive perspective that adds depth to the theoretical framework and provides valuable insights into the social and cultural dimensions that influence the implementation of AI in Saudi Arabian classrooms.

This study extended the theoretical foundation of learner autonomy by emphasizing the influential role of AI-powered applications in online education. Autonomy is no longer solely dependent on human agency but can be significantly shaped by technology. This paradigm shift broadens the conceptualization of how learners can develop and exert autonomy in digital learning environments, calling for a reevaluation of established autonomy theories. The study also introduced a nuanced perspective by highlighting that learner autonomy encompasses various facets, including collaboration, motivation, self-access, self-instruction, and self-direction. This diversified view calls upon researchers to explore a broader spectrum of factors when investigating learner autonomy in the online education context. This expansion enhances our comprehension of the multifaceted nature of autonomy in contemporary learning environments. Also, the findings offered a significant contribution to the theoretical notion that AI technology can serve as a mediating factor to enhance the quality of education and foster learner autonomy. This proposition paves the way for the development of more comprehensive models that elucidate the role of AI in mediating online learning experiences, with implications for broader educational theories. Moreover, the study presents a theoretical underpinning for the complex relationship between autonomy and guidance in online education. This underlines the need for a thoughtful reconciliation between autonomous learning and the necessity for human interaction and support within digital learning landscapes, a topic that warrants continued theoretical exploration.

Educational institutions can strategically leverage the study's findings further to integrate AI-powered applications into their online learning environments. These applications should not only facilitate self-directed learning but also actively promote collaboration, motivation, self-access, self-instruction, and self-direction. Such integration stands to enhance the overall learning experience. In addition, instructors engaged in online education should be equipped with appropriate training and support to effectively harness the potential of AI systems in promoting learner autonomy. These initiatives should extend to using AI tools to encourage self-directed learning, foster collaboration, and boost student motivation. In addition, educational institutions and course developers can benefit from revisiting and adapting their curricula to align with the principles of learner autonomy and AI integration. Curricular design should strike a harmonious balance between autonomous learning experiences and guided instruction, thereby empowering students to navigate their educational journeys.

Educational institutions and technology developers should prioritize data security, transparency, and ethical practices to mitigate potential concerns and ensure responsible AI use. AI applications can be further refined to offer personalized feedback and adapt to the unique learning needs of each student. This practical enhancement has the potential to significantly contribute to improving motivation, self-access, and self-instruction, as highlighted in the study.

In addition, to facilitate students in maximizing the benefits of AI-powered applications, educational institutions can initiate orientation programs. These programs can provide students with guidance on effective use of AI tools, enabling them to make informed decisions about their learning paths and seek human support when required. Collaboration among educators, technologists, and researchers is paramount for designing and implementing AI-powered applications that align with the principles of learner autonomy. Interdisciplinary teamwork can yield holistic solutions that enhance the online learning experience by ensuring that AI systems are effectively integrated into the pedagogical framework. Finally, the study underscores the need for ongoing research and development efforts in the field of AI in education. Institutions and technology developers should continue to innovate and enhance AI applications to better support learner autonomy in the online learning realm. Continuous improvement and innovation are essential in this ever-evolving landscape.

Despite the merits of this study, there were some limitations including potential cultural biases in survey responses and a focus on a specific educational level. Further studies can explore broader educational contexts and validate findings across diverse demographics. Examining long-term impacts of AI implementation in Saudi Arabian online education and assessing the effectiveness of cultural adaptations in AI systems would provide deeper insights. Researchers may also consider investigating the evolving role of AI in fostering learner autonomy while considering additional cultural dimensions in the Saudi Arabian context as well as other contexts.

Funding

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