AI in education: Unlocking college student engagement in the digital learning era

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ABSTRACT

This study investigated the relationships between independent variables Instructor Knowledge, Instructor Support, Ease of Access, Availability of AI Resources, Perceived Value, and Institutional Response and their impact on college student engagement in AI-driven educational contexts. Using a quantitative design, the study gathered data from 572 college students at universities in the Philippines through a structured Likert scale questionnaire on their perceptions and experiences of AI in education. Analysis through multiple regression revealed that Instructor Knowledge did not significantly influence engagement, suggesting that mere expertise may not suffice without strong interpersonal relationships. In contrast, strong Instructor Support positively correlated with student engagement, emphasizing the critical role that encouragement and guidance play in fostering student involvement. Although Ease of Access to AI tools approached significance, the availability of resources negatively correlated with engagement, indicating that an abundance of choices may overwhelm students and lead to disengagement. The Perceived Value of student feedback is positively related to engagement, underscoring the importance of institutions acknowledging and acting on student input to enhance their educational experiences. Furthermore, timely Institutional Response significantly promoted engagement by fostering transparent communication between students and institutions. These results imply that to enhance student engagement effectively, educational institutions should focus on strengthening instructor support, simplifying access to AI tools, curating resources thoughtfully, and actively responding to student feedback. This study offers important insights into AI-enhanced education, highlighting factors that can boost engagement, inform teaching practices, and influence future learning environments. By addressing these elements, institutions can create a more interactive and supportive educational experience for students in a digital learning landscape.

INTRODUCTION

The integration of Artificial Intelligence (AI) in educational environments has become increasingly prevalent, particularly among college students who are navigating the complexities of the digital learning landscape (Wang et al., 2024). A recent report from the Digital Education Council, a global partnership of universities and industry leaders focused on fostering educational innovation, found that 86% of students use artificial intelligence in their academic pursuits. Many students incorporate AI into their studies with frequency: 24% indicated they use AI daily, while 54% reported using it either daily or weekly (Kelly, 2024). This surge in AI usage has implications for student engagement. Conversely, while these tools can improve learning outcomes, research indicates that many students feel overwhelmed by the fast pace of technological advancement and frequently lack the necessary support to effectively use the resources at their disposal. Moreover, issues such as inequality in access to AI technologies and insufficient instructor support remain significant barriers. These challenges underline the necessity for a deeper exploration of how to optimize AI tools to foster greater engagement among college students.

The challenges faced by college students in effectively engaging with AI tools underscore the critical need to explore methods for optimizing these technologies to enhance student engagement. This study concentrates on three independent variables, Instructor, Accessibility, and Feedback, to address the difficulties students encounter with AI utilization. According to Kim et al. (2022) and Kim et al. (2021), the knowledge and support provided by instructors are essential for navigating the complexities of AI technologies, which greatly impact students' levels of engagement. For instance, the perceived trustworthiness of AI instructors and their social presence may improve student interactions, leading to a more engaging online learning atmosphere. Additionally, the ease of access to AI resources and the availability of technical support are fundamental to ensuring that all students can utilize these tools effectively (Morris, 2020; Goldenthal et al., 2021). Ensuring accessibility in AI-driven communication technology is crucial for fostering inclusive learning experiences that address the varied needs of students.

This study aims to explore the relationship between instructors' knowledge of AI tools and college student engagement, focusing on how enhanced instructor expertise can positively affect student participation and motivation. Research indicates that when instructors demonstrate a high level of knowledge regarding AI technologies, they are more effective at facilitating their integration into learning environments. It, in turn, fosters a sense of competence among students, leading to increased engagement levels (Zhu et al., 2024; Carr, 2023). This relationship is based on Bandura's Social Learning Theory, which suggests that individuals learn within a social context by observing and imitating others. When students see knowledgeable instructors utilizing AI effectively, they are more likely to emulate those behaviors, thus enhancing their engagement.

Additionally, this study aims to explore how instructor support for using AI tools affects college student engagement. The literature indicates that guidance and encouragement from instructors significantly enhance students' interactions with AI technologies. A supportive instructional environment boosts student motivation, increasing their likelihood of engaging with the technology (Chiu et al., 2023). When students perceive that their instructors are available to assist them, they tend to explore and utilize AI tools more, enriching their academic experience. The significance of this relationship can be understood through Self-Determination Theory, which highlights the role of relatedness and support in enhancing motivation and engagement in learners.

Furthermore, the study aims to evaluate how ease of access to AI tools affects college student engagement. Research demonstrates that when AI tools are easily accessible, students exhibit higher levels of participation and involvement (Hew et al., 2021). Accessibility removes barriers preventing students from utilizing these tools and encourages exploration and experimentation. This relationship aligns with Davis's Technology Acceptance Model, which indicates that perceived ease of use greatly affects user acceptance and engagement with new technologies.

Likewise, the research aims to examine the connection between the availability of AI resources and college student engagement. The presence of necessary AI tools plays a crucial role in facilitating student engagement in academic tasks, as readily available resources empower students to integrate these tools into their learning routines

(Ferreira et al., 2024). This relationship aligns with the Resource-Based View (RBV), indicating that valuable and accessible resources lead to competitive advantages—in this case, enhanced student engagement and educational outcomes.

Moreover, this research will assess how the perceived value of student feedback on AI tools correlates with college student engagement. According to Dann et al. (2022), acknowledging and responding to student feedback can significantly enhance engagement by fostering a sense of ownership and involvement in the learning process. Constructivist Learning Theory emphasizes active involvement and highlights the critical role of student input in shaping educational experiences.

Lastly, this research will determine how institutional responsiveness to student feedback regarding AI tools influences college student engagement. Timely and effective responses to student concerns demonstrate the institution's commitment to student satisfaction, thereby enhancing engagement levels (Hussain et al., 2018). This relationship corresponds to the Theory of Planned Behavior, which suggests that when students believe their feedback is appreciated and addressed, their intention to engage with AI technologies rises, thereby motivating them to participate more actively in their learning.

Many studies have examined the influence of artificial intelligence (AI) in educational settings, emphasizing different factors that affect student engagement and learning outcomes. For instance, Wu et al. (2024) explored the critical elements that shape self-directed learning among undergraduates in AI-enhanced educational environments. Their research found that instructor support, structured guidance, and an interactive learning atmosphere play a significant role in empowering students to take control of their learning journeys. By enhancing students' self-directed learning capabilities, AI tools enable a more personalized and engaging educational experience.

Similarly, Ramirez and Esparrell (2024) discussed the synergistic relationship between AI and education, emphasizing how AI facilitates more tailored learning experiences. Their findings indicated that when educational institutions effectively integrate AI technologies, they unlock new potential for student engagement and learning. The study highlighted the significance of strategically supporting AI tools with educational aims to maximize their effectiveness and support active learning. Murdan and Halkhoree (2024) contributed to this narrative by examining how the integration of AI promotes learning distinction and improvement in higher education institutes. Their research underscored the need for institutions to embrace AI not only as a tool for instruction but also as a means to drive pedagogical advancements. They found that such integration significantly enhances student engagement by creating immersive and stimulating learning environments. Singh (2023) focused on the transformative power of AI in higher education, noting that the incorporation of AI technologies leads to substantial improvements in teaching and learning. The study illustrated how AI systems can adapt to individual learning needs, thereby fostering engagement by ensuring that educational content resonates with students' unique preferences and learning styles.

Additionally, Radif (2024) examined how AI transforms learning environments and enhances student engagement. This research pointed out that AI's capability to support immediate response and tailor educational experiences to individual learning paces significantly increases student interest and motivation. By promoting interactive and engaging learning experiences, AI tools encourage students to be more actively involved in their education. Dede and Lidwell (2023) took a broader approach to the topic by creating an advanced model for large-scale digital learning that integrates AI technologies. Their model highlights the importance of AI in developing adaptive learning paths and personalized experiences, which are crucial for sustaining student engagement in extensive educational environments. The study identified that without incorporating AI, educational systems risk lagging in effectively meeting students' diverse learning needs.

These earlier studies collectively emphasize the vital role of AI in boosting student engagement and personalizing the learning experience. The findings emphasize the importance of instructor support, strategic integration of AI technologies, and the provision of adaptive learning experiences to foster meaningful interactions between students and educational content. The consistent thread across these studies reveals that leveraging AI in

education not only enriches learning environments but also enables institutions to cultivate engaged and self-directed learners, ultimately leading to improved educational outcomes.

The examination of various studies has revealed essential findings regarding artificial intelligence (AI) in educational contexts, particularly concerning student engagement. Previous research has highlighted that increased instructor knowledge of AI tools positively influences student motivation and participation in learning environments. Instructors who are well-versed in AI technologies tend to facilitate their integration more effectively, fostering students' sense of competence. Additionally, studies have shown that instructor support significantly enhances students' interactions with AI tools; guidance from educators boosts motivation and encourages exploration. Accessibility to AI tools also plays a critical role, with easier access leading to higher participation levels among students. The presence of necessary AI resources empowers students to incorporate these technologies into their learning routines. Furthermore, the acknowledgment of student feedback has emerged as a vital component in enhancing engagement, as responsive institutions demonstrate their commitment to student satisfaction.

In contrast to these previous studies, the recent research aims to create a more integrated understanding of how multiple factors—such as instructor knowledge, support, resource accessibility, and responsiveness to student feedback—interact to influence college student engagement. While earlier studies have often focused on these variables in isolation, the recent study seeks to explore their collective impact on student engagement, highlighting their interrelationships within a unified framework.

This comprehensive approach uncovers a research gap; existing literature tends to treat these factors separately rather than considering how they work together to enhance engagement in AI-enhanced learning environments. By filling this gap, recent research offers a comprehensive perspective crucial for understanding the complexities of AI integration in education.

Conducting this recent study is crucial as it not only aims to clarify the interconnections among these variables but also to develop actionable strategies for educators and institutions. The expected output of this study includes evidence-based recommendations that will inform pedagogical practices, ultimately fostering enhanced student engagement and facilitating a more effective integration of AI technologies within educational settings. By offering valuable insights, this research aims to significantly contribute to the field, helping to improve the overall educational experience in an increasingly digital learning landscape.

MATERIALS AND METHODS

Figure 1 presents a flowchart of the study's methodology, outlining the systematic approach the researchers used to evaluate the effects of various independent variables on student engagement. It outlined the key components, including the study design, variable identification, participant characteristics, data collection tools, and analysis procedures. This structured framework facilitated a clear understanding of the processes involved in examining the relationships among instructor knowledge, accessibility, feedback, and overall student engagement within the educational context.
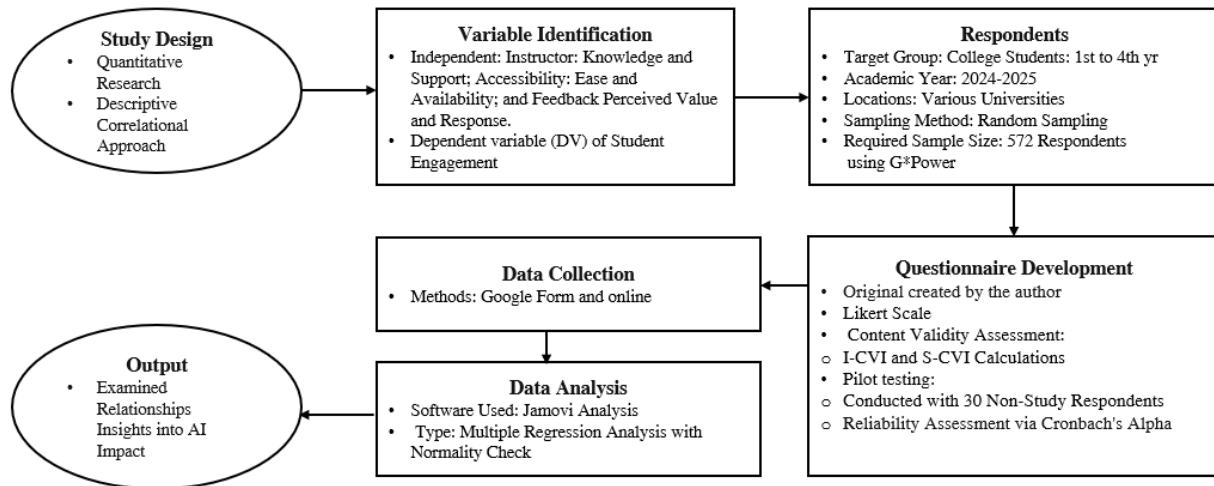
Fig. 1: Flowchart of the Study's Methodology

The study employed a quantitative design and conducted multiple regression analysis to investigate the relationships between the independent variables (IVs): Instructor Knowledge and Support, Accessibility (Ease and Availability), and Feedback (Value and Response), and the dependent variable (DV) of Student Engagement. The descriptive correlational approach emphasized understanding the associations between these variables without manipulation, allowing for the identification of natural trends and connections within the educational context. This methodology suited the investigation by providing objective measurements of students' perceptions, ultimately yielding insights that informed educational practices and enhanced student engagement with AI technologies in the digital learning era.

The study targeted college students enrolled in the academic year 2024 to 2025 at universities throughout various cities in the Philippines, including both private and public institutions, and covering 1st to 4th-year students. This diverse selection was meant to depict an expansive range of viewpoints on AI utilization in education and confirmed that the outcomes showed the experiences of students from different academic backgrounds and levels of study. Participants were selected using random sampling and a systematic approach, which ensured that each student had an equal opportunity to be included in the sample, thus reducing bias and improving the study's representativeness. The researchers utilized G*Power 3.1 to determine the necessary sample size for examining the impact of AI in educational settings. They applied a linear multiple regression model with a significance level (α) set at 0.05 and a desired power (1 - β) of 0.8, considering six independent variables. A large effect size ($f^2 = 0.35$) was chosen, indicating a significant expected impact of the independent variables on student engagement. This led to a required total sample size of 572 respondents to achieve an actual power of 0.95, ensuring a high likelihood of detecting a significant R^2 value above zero. By selecting a large effect size, the study aimed to identify meaningful relationships among the variables, thereby enhancing the validity of the findings related to the role of AI in promoting student engagement.

The researchers created an original questionnaire that utilized a Likert scale from Strongly Disagree to Strongly Agree to assess key variables related to AI in education and its effects on student engagement. This questionnaire evaluated different facets of student engagement associated with the use of AI tools in academic environments through thoughtfully designed items. In this study, the variables measured different facets of AI tool implementation in educational contexts. Instructor Knowledge evaluated instructors' understanding and integration of AI tools as well as their ability to explain and enhance instruction using these tools. Support examined the assistance instructors provided to students in utilizing AI tools, highlighting their availability for help and encouragement for exploration. The Ease of Access variable assessed how accessible and user-friendly AI tools were for students, emphasizing straightforward navigation and the ability to quickly find necessary information.

Availability of AI Resources focused on the readiness and sufficiency of access to AI tools and resources for students, including their availability outside of class time. The Perceived Value variable evaluated students' perspectives on the acknowledgment of their feedback and the importance the institution assigned to their opinions regarding the use of AI tools. The response measured the institution's responsiveness to student feedback on AI tools, including timely communication about changes made based on this input. Finally, Student Engagement, the dependent variable, evaluated the influence of AI tools on student knowledge experiences, participation in class activities, motivation for learning, and collaboration among peers. Together, these variables offered comprehensive insight into the dynamics of AI tool implementation in educational contexts, particularly in fostering student engagement.

This questionnaire underwent content validity assessment from five academic experts who are scholars in the field, evaluating relevance, clarity, and importance to ensure applicability and comprehensibility within the study's context. The primary purpose of developing the questionnaire was to collect detailed data on students' perceptions and experiences with AI tools, offering insights into the factors that affect their engagement. To assess content validity, the researchers calculated the Item Content Validity Index (I-CVI) and the Scale Content Validity Index (S-CVI). Each item was assigned an I-CVI score, with a score of 1 indicating complete agreement among experts regarding its validity (Almanasreh, Moles, & Chen, 2019; Polit & Beck, 2006). The S-CVI was obtained by averaging the I-CVIs, where an S-CVI/Average score of 1 indicated excellent content validity, particularly if the S-CVI/Universal Agreement (UA) also equaled 1 (Egger-Rainer, 2018). Since the I-CVI equaled 1 for every item and the S-CVI/Average also registered 1, the expert panel deemed all questionnaire items highly valid. The rigorous validation process supported the soundness of the instrument, aligning with established recommendations for design and validation (Polit, Beck, & Owen, 2007). After the validity assessment, the researchers performed a pilot test with 30 respondents who were not part of the study's sample. To evaluate the internal consistency of the questionnaire, the researchers used Cronbach's alpha index, a statistical measure that assesses the reliability of a set of questions in evaluating a particular concept. The overall Cronbach's alpha value of 0.931 surpassed the acceptable threshold of 0.7, indicating strong reliability for all variable items in the questionnaire (DeVellis, 2017). Table 1 presents the itemized mean scores and reliability of both independent and dependent variables.

Table 1: Itemized Mean Scores and Reliability of Independent and Dependent Variables

Category	Description	Mean	Cronbach's α
Instructor Knowledge			
Item 1	Instructors demonstrate a solid understanding of AI tools.	3.7	0.933
Item 2	Instructors effectively integrate AI tools into their teaching.	3.45	0.934
Item 3	Instructors know the latest relevant AI developments.	3.55	0.935
Item 4	Instructors provide clear explanations of how to use AI tools.	3.8	0.932
Item 5	Instructors use AI tools to enhance the quality of instruction.	3.75	0.933
Instructor Support			
Item 1	Instructors provide adequate support in using AI tools.	3.3	0.932
Item 2	Instructors encourage the exploration of AI tools.	2.9	0.93
Item 3	Instructors are available for help with AI tools when needed.	3.02	0.93
Item 4	Instructors provide constructive feedback on the use of AI tools.	3.25	0.929
Item 5	Instructors actively promote the advantages of using AI tools in knowledge.	3.35	0.931
Ease of Access			
Item 1	AI tools are easy to access for coursework.	3.95	0.931
Item 2	Using AI tools is straightforward and user-friendly.	4.25	0.932
Item 3	Navigating AI tools is simple and intuitive.	4.05	0.934
Item 4	Getting help with AI tools when needed is easy.	4.3	0.931
Item 5	I can quickly find the information I need regarding AI tools.	4.4	0.93
Availability of Resources			
Item 1	AI resources are readily available when needed.	3.8	0.933

Item 2	There is sufficient access to AI tools for all students.	3.75	0.932
Item 3	AI tools are consistently available for use outside of class time.	3.9	0.931
Item 4	The institution provides adequate resources related to AI tools.	3.25	0.932
Item 5	The infrastructure supports easy access to AI tools.	3.4	0.931
Perceived Value			
Item 1	Student feedback on AI tools is acknowledged by the institution.	3.4	0.93
Item 2	The institution values student opinions on AI implementations.	3.55	0.931
Item 3	Feedback provided by students leads to improvements in AI tools.	3.9	0.932
Item 4	Students feel their experiences with AI tools are taken seriously.	3.3	0.93
Item 5	The institution encourages students to share feedback on AI tools.	3.6	0.931
Response of Institution			
Item 1	The institution responds promptly to student feedback about AI tools.	3.6	0.931
Item 2	The institution acts on student feedback related to AI tools.	3.55	0.932
Item 3	Changes have been made to AI tools based on student feedback.	3.7	0.931
Item 4	Communication regarding the status of feedback on AI tools is clear.	4.05	0.933
Item 5	Students are informed how their feedback influenced changes.	4	0.931
Student Engagement			
Item 1	Engaging with AI tools enhances the overall learning experience.	3.75	0.931
Item 2	The use of AI tools increases participation in class activities.	3.45	0.931
Item 3	AI technologies motivate students to engage in learning.	3.75	0.932
Item 4	Interacting with AI tools clarifies complex concepts.	4	0.931
Item 5	AI tools encourage collaboration among students in academic tasks.	3.55	0.933
Overall Cronbach's alpha value 0.931			

Data collection for this study occurred through the use of a Google Form, which facilitated the efficient gathering of responses from college students regarding their perceptions of AI tools and their engagement in educational settings. The online format allowed participants easy access to the questionnaire, ensuring a diverse and representative sample from various institutions. After collecting the data, the researchers analysed the responses using Jamovi software, a user-friendly statistical platform.

The research employed multiple regression analysis to examine the relationships between the independent variables: Instructor (Knowledge and Support), Accessibility (Ease and Availability), Feedback (Value and Response), and the dependent variable of Student Engagement. The normality of the data was assessed to verify the assumptions required for regression analysis, revealing that the dataset conformed to a normal distribution. This was evidenced by a Shapiro-Wilk statistic of 0.984 (p-value = 0.450) and a Kolmogorov-Smirnov statistic of 0.075 (p-value = 0.830). The analysis yielded an intercept estimate of 2.56812 (p-value = 0.008), indicating a statistically significant baseline level of student engagement when all independent variables equaled zero.

Ethical Considerations

This study incorporated key ethical considerations, including voluntary participation and the assurance of data confidentiality. Participants provided informed consent, which ensured that they understood the study's purpose and potential impacts. By prioritizing these ethical practices, the researchers gathered valuable insights while fostering trust and transparency among participants regarding their involvement in the study.

RESULTS AND DISCUSSION

Model Fit Measures of Influences on Student Engagement

The study investigated the effects of various factors, including instructor knowledge, support, ease of access, availability of resources, perceived value of feedback, and institutional response, on student engagement. The overall model's fit is summarized in Table 2. The correlation coefficient (R) was 0.851, indicating a strong positive relationship between the independent variables and student engagement. The coefficient of determination (R^2) was 0.725, explaining approximately 72.5% of the variance in student engagement. An F-statistic of 45.6 was calculated with degrees of freedom df1 = 6 and df2 = 257, and the significance level was $p < 0.001$, confirming that the overall model is statistically significant.

Table 2: Summary of Model Fit

Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.851	0.725	0.719	45.6	6	257	< 0.001

Results of Influences on Student Engagement

This research aimed to explore the influences of several factors, including instructor knowledge, support, ease of access, availability of resources, perceived value of feedback, and institutional responses on student engagement. The results, summarized in (Table 3), indicated significant findings regarding these predictors' relationships with student engagement.

The intercept was estimated at 2.56 (SE = 0.91, β = 2.77, t = 2.77, p = 0.008), establishing a baseline for student engagement. Instructor Knowledge demonstrated a negligible effect with a coefficient of 0.05 (SE = 0.10, β = 0.55, t = 0.55, p = 0.578), indicating no significant relationship with student engagement. In contrast, Instructor Support demonstrated a significant positive association (β = 0.21, SE = 0.09, t = 2.25, p = 0.025), indicating that greater support from instructors improves student engagement.

The Ease of Access variable approached significance with a coefficient of 0.15 (SE = 0.09, β = 1.65, t = 1.65, p = 0.098), indicating a potential positive impact on engagement. The variable Availability yielded a negative coefficient of -0.31 (SE = 0.12, β = -2.43, t = -2.43, p = 0.015), suggesting that greater availability of resources may correlate with decreased engagement levels.

The Perceived Value of Feedback produced a robust positive relationship, with a coefficient of 0.33 (SE = 0.08, β = 4.16, t = 4.16, p < 0.001), highlighting the importance of valuing student feedback in fostering engagement. Finally, Institutional Response displayed a notable positive impact with a coefficient of 0.45 (SE = 0.09, β = 4.73, t = 4.73, p < 0.001), indicating that timely and effective feedback from institutions greatly improves student engagement.

Table 3: Summary of Student Engagement Coefficients

Predictor	Estimate	Standard Error (SE)	β	t	p
Intercept	2.56	0.91	2.77	2.77	0.008
Instructor knowledge	0.05	0.10	0.55	0.55	0.578
Instructor support	0.21	0.09	2.25	2.25	0.025
Ease of use	0.15	0.09	1.65	1.65	0.098
Availability of resources	-0.31	0.12	-2.43	-2.43	0.015

Perceived value	0.33	0.08	4.16	4.16	< 0.001
Institutional response	0.45	0.09	4.73	4.73	< 0.001

Summary of Predictors' Impact on Student Engagement

Table 4 presents a concise overview of the relationships between key factors and student engagement. The key findings indicate that Instructor Support, Perceived Value of Feedback, and Institutional Response have significant positive effects on engagement, while Availability of Resources has a significant negative effect. Factors such as Instructor Knowledge and Ease of Access show no significant correlation with student engagement.

Table 4. Summary of Predictors' Impact on Student Engagement

Predictor	Significance	Correlation Type
Instructor knowledge	Not Significant	None
Instructor support	Significant	Positive
Ease of access	Not Significant	None
Availability of resources	Significant	Negative
Perceived value	Significant	Positive
Institutional response	Significant	Positive

The Role of Instructor Knowledge in Student Engagement

The first finding reveals that instructor knowledge does not significantly impact student engagement in artificial intelligence, suggesting that meaningful relationships and effective interaction are more crucial for fostering engagement. Students thrive in environments where relationships with their instructors are strong. Instructors with AI expertise might hesitate to share their knowledge due to concerns about academic dishonesty or students becoming overly dependent on AI. This finding aligns with Lee (2024), which emphasizes that tailored learning environments significantly influence EFL learner engagement and highlights the importance of customizing interactions rather than relying solely on instructor knowledge. Similarly, Seo et al. (2021) demonstrate that learner-instructor interactions, rather than the instructor's technological proficiency, remain pivotal in online learning contexts. Therefore, while current findings about instructor knowledge are consistent with these studies, they uniquely stress the necessity of relationship-building and interactive strategies to enhance student engagement in AI-supported education.

The Impact of Instructor Support on Student Engagement

The second finding reveals that instructor support has a significant and positive correlation with student engagement, indicating that strong support from instructors directly enhances students' involvement in their learning experiences. This finding is consistent with the study conducted by Chiu et al. (2024), which emphasizes the critical role of teacher reinforcement in motivating students to engage with AI-based chatbots. Dwyer and Larson (2023) corroborate these results, revealing that strong instructor support positively influences student motivation and engagement. They emphasize that supported students tend to explore AI resources more, which leads to deeper engagement in their studies. When students perceive their instructors as approachable and supportive, they actively engage with the material and explore new concepts more freely. Therefore, the findings underscore the importance of building trust and maintaining open communication between instructors and students to enhance engagement in educational environments that utilize AI.

The Impact of Ease of Access on Student Engagement

The third key finding reveals that Ease of Access is not significant in student engagement, suggesting that while access to AI tools approached significance, it did not achieve statistical significance. This implies that simplifying access to AI tools could potentially enhance engagement, though variations in students' familiarity with AI technologies may have contributed to this outcome. Research by Hew et al. (2021) shows that ease of use significantly affects students' willingness to engage with new technologies, indicating that challenges in accessing AI tools can diminish their willingness to participate. Similarly, Hang (2024) emphasizes the importance of adoption and ease of use, noting that these factors, along with teachers' experiences, play a vital role in teaching effectiveness and may moderate student interest. Both studies align with the current findings, highlighting the consistent necessity for ensuring accessibility alongside technological implementation to foster greater engagement among students.

The Impact of Availability of Resources on Student Engagement

The fourth key finding reveals that while the availability of resources significantly affects student engagement, it correlates negatively. This result implies that an abundance of resources may overwhelm students, leading to disengagement rather than enhancing their learning experiences. Potential explanations for this negative correlation include decision fatigue, where too many options hinder students' ability to choose effectively and focus on relevant materials. Bharti and Singh (2018) emphasize that excessive choices can lead to this fatigue, highlighting the importance of curating resources to promote student focus and engagement. This aligns with Bognár et al. (2024), who also examine how the quantity and quality of resources impact engagement in AI-enhanced learning environments. Similarly, Nguyen et al. (2024) address the need for thoughtfully integrating resources to leverage AI effectively. Collectively, these studies confirm the unique finding that while resources are important for engagement, their effectiveness relies on careful curation and moderation to prevent overwhelm and maintain student interest.

The Impact of Perceived Value on Student Engagement

The fifth finding shows that Perceived Value is significant to student engagement, indicating that when students recognize the worth of their educational experiences, their active involvement increases. This finding supports with investigation by Dann et al. (2022), which emphasizes that valuing student input fosters a stronger sense of ownership and motivation, leading to heightened engagement levels when students see their feedback acted upon. Similarly, Al Issa et al. (2024) demonstrate that students' perceived value of online learning directly affects their engagement in higher education, reinforcing the idea that recognizing the benefits of educational tools enhances commitment to learning. Both studies consistently highlight the importance of perceived value in driving student engagement, while the current findings uniquely focus on the role of perceived value specifically in AI-enhanced learning environments.

The Impact of Institutional Response on Student Engagement

The finding that Institutional Response significantly relates to student engagement in artificial intelligence, with a positive correlation, implies that timely and effective feedback from institutions enhances students' involvement in their educational experiences. This aligns with the research by Dann et al. (2022), which highlights that addressing student feedback through AI improves engagement and fosters a more responsive learning environment. Radif (2024) supports this notion by discussing how effective institutional responses transform learning environments and boost student engagement. Both studies consistently underscore the necessity of responsive institutional practices, while the current findings uniquely emphasize the role of such responses specifically in AI-enhanced educational settings, further reinforcing the importance of institutional involvement in promoting student engagement.

Limitations of the Study

This research has numerous restrictions. Firstly, it depends on respondents-reported measures, which may introduce biases from social desirability or inaccuracies in participants' perceptions. Secondly, its focus on college students in the Philippines restricts the generalizability of the findings. Additionally, the cross-section design collects data at a single point in time, hindering the ability to assess changes in engagement over time. Lastly, the study does not distinguish between different AI tools and their individual effects on student engagement.

Future Directions for Research

Future research should pursue several key areas. Longitudinal studies can track changes in student engagement over time. Researchers should also incorporate qualitative methods, such as interviews, to gain deeper insights into students' experiences with AI tools. Investigating the effectiveness of specific AI technologies will reveal which best promotes engagement. Expanding the demographic scope to include diverse institutions and regions will enhance generalizability. Lastly, examining teacher training programs' roles in effectively using AI tools will help establish best practices in educational technology integration.

CONCLUSION AND RECOMMENDATION

Conclusions

The study's findings highlight six key conclusions regarding factors affecting student engagement in artificial intelligence education. First, instructor knowledge does not significantly impact student engagement, emphasizing the need for strong relationships and interactions between instructors and students. Second, instructor support positively correlates with student engagement, indicating that approachable and supportive instructors enhance students' active involvement. Third, while ease of access to AI tools approaches significance, it does not significantly affect engagement, suggesting that simplifying access may enhance involvement. Fourth, the availability of resources significantly impacts student engagement but correlates negatively, indicating that an abundance of resources may overwhelm students, causing disengagement. Fifth, perceived value is crucial for student engagement, as understanding the benefits of educational experiences encourages active participation. Lastly, effective institutional responses positively correlate with student engagement, underscoring the importance of timely feedback and support from institutions.

Recommendations

Based on these conclusions, the following recommendations can enhance student engagement in AI-supported education:

1. Foster strong relationships between instructors and students to create an engaging learning environment.
2. Provide consistent and actionable support from instructors to motivate students and enhance their learning experiences.
3. Simplify access to AI tools and provide training to increase students' familiarity and comfort with the technology.
4. Curate resources thoughtfully to prevent decision fatigue and promote focused engagement among students.
5. Highlight the perceived value of educational experiences by actively involving students in feedback processes and integrating their input into learning activities.
6. Encourage institutions to implement timely feedback mechanisms and responsive practices that enhance student involvement and engagement in educational settings.

REFERENCES

Al Issa, H. E., Omar, M. M. S., & Çelebi, A. (2024). Higher education student engagement with online learning: The role of perceived value and academic entitlement. *Higher Education, Skills and Work-Based Learning*, 14(3), 545-561.

Bharti, S., & Singh, S. (2018). The impact of decision fatigue on engagement in educational settings. International *Journal of Education and Management Studies,* 8(3), 182-187.

Bognár, L., Ágoston, G., Bacsa-Bán, A., Fauszt, T., Gubán, G., Joós, A., & Strauber, G. (2024). Re-evaluating components of classical educational theories in AI-enhanced learning: An empirical study on student engagement. *Education Sciences*, 14(9), 974.

Carr, B. (2023). Revolutionizing education: Unleashing the power of Chat GPT/AI to empower educators. Technology and the Curriculum: *Summer 2023*.

Chiu, T. K., Moorhouse, B. L., Chai, C. S., & Ismailov, M. (2023). Teacher support and student motivation to learn with Artificial Intelligence (AI)-based chatbot. *Interactive Learning Environments*, 1-17. https://doi.org/10.1080/10494820.2023.2184347

Dann, C., Redmond, P., Fanshawe, M., Brown, A., Getenet, S., Shaik, T., & Li, Y. (2022). Making sense of student feedback and engagement using artificial intelligence. *Australasian Journal of Educational Technology*, 38(2), 43-56. https://doi.org/10.14742/ajet.6960

Dede, C., & Lidwell, W. (2023). Developing a next-generation model for massive digital learning. *Education Sciences*, 13(8), 845. https://doi.org/10.3390/educsci13080845

Dwyer, S., & Larson, T. (2023). The impact of feedback on student engagement in digital learning. *International Journal of Tech in Education*, 5(1), 15-29.

Egger-Rainer, M. (2018). Consultation on statistical methods for the analysis of questionnaire validity. *Statistical Journal of the IAOS*.

Ferreira, R., Sabino, C., Canesche, M., Neto, O. P. V., & Nacif, J. A. (2024). AIoT tool integration for enriching teaching resources and monitoring student engagement. *Internet of Things*, 26, 101045. https://doi.org/10.1016/j.iot.2024.101045

Hang, N. T. (2024). The role of adoption, ease of use and teachers' experience of artificial intelligence on teaching effectiveness: Moderating role of student interest. *Journal of Pedagogical Research*, 8(4), 16-29.

Hew, K. F., Huang, W., Du, J., & Jia, C. (2021). Using chatbots in flipped learning online sessions: Perceived usefulness and ease of use. *In Blended Learning: Re-thinking and Re-defining the Learning Process. 14th International Conference*, ICBL 2021, Nagoya, Japan.

Kelly, R. (2024, August 28). Survey: 86% of students already use AI in their studies. Campus Technology. https://campustechnology.com/articles/2024/08/28/survey-86-of-students-already-use-ai-in-their-studies.aspx

Kim, J., Merrill Jr, K., Xu, K., & Kelly, S. (2022). Perceived credibility of an AI instructor in online education: The role of social presence and voice features. *Computers in Human Behavior*, 136, 107383. https://doi.org/10.1016/j.chb.2022.107383

Lee, S. (2024). EFL learner perceptions and engagement of a customized AI-led class. *RELC Journal*, 1-18. https://doi.org/10.1177/00336882241268662

Lee, H., Phatale, S., Mansoor, H., Mesnard, T., Ferret, J., Lu, K., & Prakash, S. (2023). Rlaif: Scaling reinforcement learning from human feedback with AI feedback. arXiv preprint arXiv:2309.00267. https://arxiv.org/abs/2309.00267

Morris, M. R. (2020). AI and accessibility. Communications of the ACM, 63(6), 35-37. https://doi.org/10.1145/3310412

Nguyen, A., Kremantzis, M., Essien, A., Petrounias, I., & Hosseini, S. (2024). Enhancing student engagement through artificial intelligence (AI): Understanding the basics, opportunities, and challenges. *Journal of University Teaching and Learning Practice*, 21(06).

Kim, J., Merrill Jr, K., Xu, K., & Sellnow, D. D. (2021). I like my relational machine teacher: An AI instructor's communication styles and social presence in online education. *International Journal of Human–Computer Interaction*, 37(18), 1760-1770. https://doi.org/10.1080/10447318.2021.1937300

Lee, H., Phatale, S., Mansoor, H., Mesnard, T., Ferret, J., Lu, K., & Prakash, S. (2023). Rlaif: Scaling reinforcement learning from human feedback with AI feedback. arXiv preprint arXiv:2309.00267. https://arxiv.org/abs/2309.00267

Morris, M. R. (2020). AI and accessibility. Communications of the ACM, 63(6), 35–37. https://doi.org/10.1145/3310412

Ponnusamy, P., Ghias, A., Yi, Y., Yao, B., Guo, C., & Sarikaya, R. (2022). Feedback-based self-learning in large-scale conversational AI agents. *AI Magazine*, 42(4), 43-56. https://doi.org/10.1609/aimag.v42i4.20929

Radif, M. (2024). Artificial intelligence in education: Transforming learning environments and enhancing student engagement. *Educational Sciences: Theory & Practice*, 24(1), 93-103. https://doi.org/10.12738/estp.2024.1.006

Ramirez, E. A. B., & Esparrell, J. A. F. (2024). Artificial Intelligence (AI) in education: Unlocking the perfect synergy for learning. *Educational Process: International Journal*, 13(1), 35-51.

Seo, K., Tang, J., Roll, I., Fels, S., & Yoon, D. (2021). The impact of artificial intelligence on learner–instructor interaction in online learning. *International Journal of Educational Technology in Higher Education*, 18, 1-23.

Singh, R. J. (2023). Transforming higher education: The power of artificial intelligence. *International Journal of Multidisciplinary Research in Arts, Science and Technology*, 1(3), 13-18.

Wang, S., Wang, F., Zhu, Z., Wang, J., Tran, T., & Du, Z. (2024). Artificial intelligence in education: A systematic literature review. *Expert Systems with Applications*, 252, 124167.

Wu, D., Zhang, S., Ma, Z., Yue, X. G., & Dong, R. K. (2024). Unlocking potential: Key factors shaping undergraduate self-directed learning in AI-enhanced educational environments. *Systems,* 12(9), 332.