An Investigation Of Teachers' Pedagogical Integration Of Artificial Intelligence-Based Educational Technologies

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Abstract

The emerging contentions of Artificial Intelligence (AI) in the academic landscape necessitate understanding the factors influencing teachers' decision to integrate this nascent technology. However, research on this phenomenon remains extant, particularly in the K-12 setting. As a result, this descriptive-correlational study aims to identify the determinants of teachers' integration of AI educational technologies. This work is grounded on the tenets of the Unified Theory of Acceptance and Use of Technology (UTAUT). A validated questionnaire was administered to senior high school teachers selected through total enumeration. The data gathered were subjected to regression analysis to measure the influence of manifold factors on teachers' integration of AI. Results of the study reveal that teachers' decision to integrate AI educational technologies is significantly determined by performance expectancy, effort expectancy, social influence, and facilitating conditions. The study underscores the importance of principal and collegial support, AI investment, and involvement of AI developers in successfully integrating AI into educational environments.

Keywords: artificial intelligence, behavioral intention, K-12 education, pedagogical integration, UTAUT

Introduction

The advent of Artificial Intelligence (AI) in the current industrial revolution is initiating a paradigm shift in the education sector. According to Pantelimon et al. (2021), artificial intelligence is a necessary technology in education to adapt to the needs of the current industrial revolution. Abulibdeh et al. (2024) stated that the main objective of artificial intelligence in education is to create

a revolution in teaching and prepare students to be responsible workers and citizens in the age of digitalization. Faraj (2022) stated that leveraging artificial intelligence can help develop students' soft skills, lifelong learning skills, and digital skills, which are required in today's competitive and evolving labor market. In support of this, Alekseeva et al. (2021) affirmed that the demand for a workforce equipped with AI skills can indicate the integration of AI technology.

However, the widespread recognition of artificial intelligence continues to accelerate the discussion regarding its integration into educational settings. Ghamrawi et al. (2023) explained that while many teachers believe that artificial intelligence can potentially transform education, others maintain reservations about its utilization. As a result, researchers explored the factors that determine teachers' integration of artificial intelligence educational technologies.

In particular, Sharawy (2023) assessed the factors affecting the willingness of faculty members to use AI in higher education institutions in Egypt using the Theory of Acceptance and Use of Technology. The research highlighted that the faculty members recorded high scores on performance expectancy, effort expectancy, and social influence. As evident in other studies, the faculty members consider the relevance of AI in their teaching performance, the level of ease when using AI tools, and the influence of their colleagues.

The study emphasizes the potential of AI to revolutionize education by personalizing learning, reducing effort, and providing equitable solutions. However, it also acknowledges the challenges, such as data privacy concerns, infrastructure limitations, the need for educator upskilling, and the absence of a clear policy or strategy. The passage concludes that despite these challenges, AI's benefits in higher education cannot be ignored, and universities in Egypt should continue to explore and experiment with AI to enhance education quality and accessibility.

Moreover, Alhwaiti (2023) studied the acceptance and impact of artificial intelligence (AI) in education post-pandemic, focusing on faculty members' occupational well-being and teaching self-efficacy. The researchers employed a non-experimental survey design to gather data from faculty members at Umm Al-Qura University through an online questionnaire. The study considered the UTAUT 2 Model, an extended form of the UTAUT. This model includes Performance Expectancy, Facilitating Conditions, Social Influence, Hedonic Motivation, Habit, and Price Value. The study revealed that these constructs significantly

influence faculty members' occupational well-being and teaching self-efficacy, positively affecting their integration of AI Applications in education.

The study emphasized that teachers use AI-based applications based on their influence to improve their job performance and the ease they experience when using the technology. In addition, teachers consider AI applications that provide support to their work and an enjoyable experience as they navigate its functions. Also, the application is a usual tool for them to utilize independently and is viewed positively by their peers and colleagues. Finally, the teachers consider the monetary costs and benefits of integrating AI applications.

It can be noted that the studies mentioned above considered Artificial Intelligence in higher education. This can be attributed to the response of universities to students' meeting the changing demands of the global market (Bates et al., 2020). As AI continues to transform the field of education, research on this topic is also emerging in the K-12 setting (Rizvi et al., 2023).

For instance, An et al. (2022) aimed to examine teachers' perceptions, knowledge, and intention to use AI in teaching English in the K-12 setting. The researchers selected a sample of English for Foreign Language (EFL) teachers in a school district in China. The study considered factors of AI integration such as Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC), which are based on the aforementioned theoretical model. These factors were substantiated by the Technological Pedagogical and Content Knowledge (TPACK) framework to gain a deeper understanding of the phenomenon under study.

The researchers found that the most influential factor in the UTAUT Model is Performance Expectancy. In this construct, the teachers believe that AI can assist them in teaching effectively by increasing the effectiveness and quality of instruction. It is also important to note that TPACK directly influences teachers' intention to use AI. This means that the teachers considered in the study are willing to use AI provided they have the necessary knowledge to integrate the technology considering their content and pedagogical knowledge into their teaching.

Artificial intelligence (AI) is gaining attention in education, revolutionizing classroom instruction and learning experiences. From this, it is crucial to identify the factors that influence teachers to use AI technologies, but research on this topic is still sparse (Zhang et al., 2023). Specifically, Woodruff et al. (2023) asserted

that research on AI in K-12 Education is limited. As a result of these gaps, this study explored senior high school teachers' perceptions of the critical determinants of their intention to integrate AI educational technologies to manage their pedagogical tasks.

Theoretical Framework

This study is anchored to the Unified Theory of Acceptance and Use of Technology (UTAUT) to gain empirical insight into the emergence of AI technologies in the educational landscape. The UTAUT was derived from different theoretical models, which include the Technology Acceptance Model, Theory of Planned Behavior, Theory of Reasoned Action, Motivational Model, Model of PC Utilization, and Innovation Diffusion Theory. The UTAUT is a technology acceptance model proposed by Venkatesh et al. (3003) after examining the different technology acceptance models. They disclosed that the UTAUT explains 70% of the variance of usage behavior, which is better than the previously mentioned models.

The UTAUT model suggests that the actual use of technology is determined by behavioral intention. Phuoc (2022) elucidated that the purpose of the UTAUT model is to explain users' behavioral intentions to use new technology. Setiawan et al. (2022) define behavioral intention as the willingness of a person to perform a particular behavior. In this study, behavioral intention reflects the decision-making process, where teachers decide whether or not they intend to integrate AI educational technologies. Teachers' decision is affected by performance expectancy, effort expectancy, social influence, and facilitating conditions.

These constructs are defined by An et al. (2022) in the context of Artificial Intelligence in Education (AIED) based on the definitions presented by Venkatesh et al. (2003). An et al. (2022) defined performance expectancy as the degree to which a teacher perceives that integrating AI technologies improves performance. Moreover, effort expectancy refers to the degree to which a teacher perceives that integrating AI technologies is free of effort. In addition, social influence refers to the degree to which a teacher perceives that integrating AI technologies is important according to others' beliefs. Finally, facilitating conditions refer to the degree to which a teacher perceives that technical infrastructure exists to support the integration of AI technologies.

Methodology

Research Design

This study employed a descriptive-correlational research design, which explains the extent of the relationship among variables. This is apt for this undertaking as it describes how teachers' perceptions about AI integration relate to their behavioral intention to integrate these emerging technologies into the educational setting.

Respondents

This research considered senior high school teachers as respondents to this endeavor. The researcher selected the respondents through complete enumeration. The data provided by these respondents aims to substantiate the scarce information about artificial intelligence in K-12 education. The respondents agreed to participate in the current study.

Research Instrument

The researcher used a questionnaire to attain the purpose of this study. This questionnaire was adapted from the work of An et al. (2022), which was subjected to reliability analysis. The research instrument was further validated by education experts. These ensure that the instrument is consistent across multiple administration processes and accurately measures what it intends to measure.

Data Gathering Procedure

Before gathering data, the researchers wrote a letter of permission addressed to the head of the study's locale. After the approval, a letter of consent was given to teachers. All teachers agreed to participate in the study. The questionnaires were administered to teachers simultaneously. Finally, the questionnaires were retrieved for data analysis.

Data Analysis

The researcher utilized multiple linear regression analysis to quantitatively describe the influence of multiple independent variables on the dependent variable of this study. In this case, this statistical tool was used to measure how performance expectancy, effort expectancy, social influence, and facilitating conditions determine teachers' behavioral intention to integrate Artificial Intelligence Educational Technologies.

Results and Discussion

The following table presents teachers' perceptions of AI integration as determinants of their behavioral intention to integrate AI educational technologies.

Perceptions	β	SE	t	p

Performance Expectancy	0.43	0.03	15.73	0.0000
Effort Expectancy	0.09	0.03	3.39	0.0007
Social Influence	0.15	0.02	8.44	0.0000
Facilitating Conditions	0.07	0.02	3.22	0.0013

Performance Expectancy

The table shows the computed p-value between performance expectancy and behavioral intention is 0.00 (t=15.73), lower than the threshold value of $\alpha = 0.05$. In this case, the researcher has enough evidence to accept the hypothesis that performance expectancy significantly influences teachers' behavioral intention toward integrating AI technologies. Furthermore, the analysis results show a direct relationship between the variables, as indicated by the regression coefficient of $\beta = 0.43$. In this study, teachers who expect AI to enhance their performance are more likely to integrate the technology into their pedagogy.

This confirms the findings of An et al. (2022), which showed that teachers are inclined to adopt AI technology because they expect that it will enhance their teaching performance. Similarly, Sharawy (2023) indicated that the willingness of faculty members to use AI in higher education institutions is influenced by their perception of the technology's contribution to improving their performance. The same results transpired in the work of Alhwaiti (2023), where teachers' view of AI as an assistive technology to enhance their performance affects their decision to integrate it into their pedagogy. Teachers use AI technologies to accomplish mundane tasks like grading students' papers (Kumar, 2023), checking plagiarism content (Zawacki-Richter et al., 2019), and preparing lesson plans (Kehoe, 2023). This shows that teachers integrate specific AI technologies aligned with their tasks' demands. This exhibits the Technology-Task Fit theory, which posits that technology like AI is integrated when it meets the requirements of the users' tasks (Rai & Selnes, 2019). Spies et al. (2020) added that when technology fits the characteristics of the task it intends to support; it leads to enhanced performance. This situation is evident in the study of Mohammad et al. (2022), which found that integrating AI technologies improves teachers' performance. The researchers assessed how AI affects teaching, learning, and administrative and management areas of education. The researchers highlighted that employing AI technologies such as chatbots as a pedagogical tool has enhanced teachers' work efficiency, effectiveness, and quality.

As a significant determinant of teachers' behavioral intention towards integrating AI technologies, sustaining the teachers' perception that these novel technologies can improve teachers' performance is crucial. This can be achieved by involving teachers in the institution's decision-making process when integrating AI educational technologies. Consequently, this involvement ensures that the AI technologies implemented align with teachers' tasks to address their actual needs.

Effort Expectancy

The table shows that the p-value of 0.0007 (t=3.39) is lower than the threshold value of 0.05. This indicates that the hypothesis is accepted, denoting that effort expectancy is significantly related to teachers' behavioral intention to integrate AI technologies into their pedagogy. The regression coefficient of β=0.09 shows a direct relationship between effort expectancy and behavioral intention. This suggests that teachers who perceive that the use of AI educational technology is easy are inclined towards its integration.

The finding of this study is consistent with Sharawy (2023), who pointed out that teachers who perceive AI as a tool with no particular difficulty are more likely to use it in the long run. Similarly, the study of Alhwaiti (2023) established that teachers integrate AI technologies when the integration is free of effort. This may be because teachers use AI technologies to streamline their time-consuming tasks, which can alleviate their burden. On the contrary, teachers feel mentally exhausted by new technologies that are multifaceted and require tremendous effort to use. This situation can be explained by the extraneous cognitive load in cognitive load theory, which requires users to expend unnecessary mental effort stemming from usability, such as the demands posed by interfaces (Skulmowski & Xu, 2021). In line with this, AI technologies with complex interfaces can increase extraneous cognitive load, making it more difficult for teachers to perform tasks. This cognitive load is a crucial concept in user experience design, as it directly impacts how users interact with digital interfaces (de Jong, 2010).

Researchers also explored how complex technologies in the workplace context negatively impact employee well-being. According to Rasool et al. (2022), when overly complex technology functions are implemented in the workplace, they can increase employee stress levels. This pertains to techno-complexity, the stress induced by spending more time and effort dealing with the complexities of new technologies such as AI (Khlaif et al., 2022). For this reason, Priya Gupta and Bhaskar (2020) found that complexity is one of the factors that hinder teachers from using AI-based educational applications. As a result of this undertaking, AI

technologists are encouraged to develop technologies to keep abreast with technological innovations and, more importantly, to develop user-friendly AI educational technologies. They may consider cognitive load and technostress to be vital factors in the design of the interfaces of AI tech. In addition, pilot programs can be implemented to allow teachers to experiment with AI technologies. This can provide teachers time to learn and be adept at using these technologies, which can avert their burden.

Social Influence

It can be noticed from the table that the computed p-value of 0.00 (t=8.44) is less than the significance level of 0.05. This result accepts the hypothesis that social influence significantly influences teachers' behavioral intention to integrate AI technologies into their pedagogy. The regression coefficient of $\beta = 0.15$ specifies a direct relationship between social influence and behavioral intention. In this study, teachers who perceive AI educational technology as necessary based on their colleagues' beliefs are willing to integrate it into their pedagogy.

The finding of this study substantiates the work of Sharawy (2023) and Alhwaiti (2023), where social influence is significantly related to teachers' decision to adopt AI. That is, teachers will use AI because of the influence of their colleagues.This finding can be attributed to how teachers model their colleagues in their workplace, which highlights Social Learning Theory. Cilliers (2021) explained that social learning theory emphasizes that knowledge is acquired through observation, imitation, and modeling of others within a social context. Researchers have shown how a colleague as a model impacts teachers' decisions to learn AI technologies. For instance, Sanusi et al. (2024) investigated pre-service teachers' intentions to learn AI. The study revealed that the pressure applied by their colleagues plays a pivotal role in their decision to learn AI.

While peer influence is an external factor, teachers consider the opinions of their colleagues to feel a sense of belongingness. According to the Self-determination Theory, this situation pertains to relatedness, defined as the desire to feel connected with others (Ryan & Deci, 2000). In this study, teachers feel a sense of connection with their colleagues in the workplace when they use AI technologies that their colleagues are using. The finding of this study underpins the importance of collaboration in the workplace. In this regard, the institution can create platforms for teachers to collaborate and share best practices and innovative ways to integrate AI educational technologies.

Facilitating Conditions

The table shows that the p-value of 0.0013 is lower than the significance level of 0.05 (t=3.22). Thus, the analysis supports the hypothesis that a significant relationship exists between facilitating conditions and teachers' behavioral intention toward AI integration. Furthermore, the regression coefficient β=0.07 indicates a direct relationship between the variables. In this study, teachers who perceive that technical infrastructure is limited to support the integration of AI educational technology are less likely to integrate it into their pedagogy.

The findings of this study are consistent with the findings of Alhwaiti (2023), who disclosed that facilitating conditions directly affect teachers' willingness to integrate AI technologies. In other words, teachers refuse to integrate AI technologies due to insufficient technical support. This can be ascribed to teachers' insufficient technological self-efficacy, which suggests their need for technical support. Gomez et al. (2021) defined technological self-efficacy as the ability of teachers to perform tasks using technology successfully. Recent studies have explored how self-efficacy affects the integration of AI technologies. The work of Zhang et al. (2023) showed that pre-service teachers who exhibit lower levels of self-efficacy in utilizing AI technology typically demonstrate lower levels of confidence and proficiency.

In this study, teachers' self-assessments reveal a limited belief in their technology capabilities, which indicates the value of technical support interventions. Zheng et al. (2018) explained that technical support is necessary for teachers with poor technological self-efficacy. This intervention contributes to their inclination to integrate AI educational technologies. Given the above discussion, it is vital for institutions to provide technical support for teachers, as AI technologies are already the trend in education. Additionally, institutions may conduct an AI Professional Development Program to enhance teachers' capabilities when dealing with AI educational technologies while preparing for this digital revolution.

Conclusions and Recommendations

This study explored teachers' perceptions of AI as determinants of their intention to integrate these emerging technologies into their pedagogy. In line with the Unified Theory of Acceptance and Use of Technology, the findings of this study confirm that performance expectancy, effort expectancy, social influence, and facilitating conditions have a direct and significant relationship with their behavioral intention toward AI integration. This study revealed that teachers who believe that using AI technology can lead to an improved performance are more inclined towards its integration into the academic landscape. Moreover, teachers who perceive AI as easy to use are more likely to integrate the technology into their

teaching practices. In addition, teachers consider the approval of their colleagues when deciding to integrate AI educational technologies. On the other hand, limited technical infrastructure poses a barrier to integrating AI educational technologies. The researcher underscores the investment in AI technologies for teachers to support their integration in an era of technological innovations. Moreover, the researcher highlights the benefit of teachers' participation in organizational decision-making processes, collegial collaboration in the workplace, and professional development for teachers to integrate these emerging technologies successfully. In addition, this study provides empirical data for AI developers to consider when designing AI educational technologies. Finally, the generalizability of the findings may require further investigation.

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