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RESEARCH ARTICLE

Redefining Education through Artificial Intelligence: An In-depth Analysis of Faculty Knowledge Dimensions and AI Chatbots Integration in Enhancing Teaching Effectiveness in Higher Education Institutions

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ABSTRACT

As artificial intelligence continues to shape education, it is essential to integrate tools like chatbots into the classroom. The interest in using chatbots is quite visible due to the popularity of information technology, which gave rise to technology-based education. It is not enough for the faculty to only use the technology; moreover, knowing how efficiently it is used to deliver effective learning outcomes is important. Many studies have been done on chatbot integration in the education domain. However, scant studies have been done on the faculty-specific knowledge dimension and its effect on efficient chatbot integration in education. In our study, we explore the role of faculty knowledge dimensions in the positive integration of chatbots in educational settings, focusing on the relationship between various faculty knowledge domains, Technological Knowledge, Pedagogical Knowledge, and Content Knowledge, and how technology acceptance and the ability to synergize with digital tools influence the teaching and learning process with the effective integration of the AI chatbot in Higher education Institutions. We have collected data from 254 faculty members through a structured questionnaire with a snowball sampling method. A linear regression analysis is used to study the relationships between various faculty knowledge dimensions and the effectiveness of chatbot integration in education. We found that technological skills and a willingness to embrace digital tools are key success factors. Our study findings highlight the need for universities to invest in targeted professional development programs that improve faculty's technological expertise and encourage the collective use of digital tools in education that help educators build their technological skills and confidence. By doing so, institutions can ensure that digital tools like chatbots are used effectively to enhance teaching and learning. Future research could expand to identify why faculty with higher content knowledge view AI chatbots as less effective and develop strategies to solve this issue.

INTRODUCTION

History shows that new technologies can transform society. AI has been digitally reshaping many sectors recently, including education, one of its most significant beneficiaries. Let us break down what AI is. AI is artificial intelligence that permits machines to do the jobs where human cognition was traditionally required. AI-assisted programs and tools can make independent decisions, solve problems, mimic natural language and understand unstructured data. Every day, we encounter

artificial intelligence, like playing chess with robots and doing assisted tasks with virtual assistants like "Siri" and "Alexa" to scroll through social media and information. Most educational institutions have incorporated bots in the admission process, where bots handle admission inquiries for course information and different student services by delivering reminders. By 2030, 45% of the economic gains will be from AI-stimulated consumer demand(Rao & Verweij, 2017). Education is the foundation for personal growth and social progress. It helps individuals acquire the necessary skills and knowledge to improve their lives and the community's well-being. Education is the building block for the nation's economic growth by building an informed and capable population. With the advent of AI, we feel that we have entered a new era in education; AI has given global access to quality education. Using AI chatbots in educational institutions will improve teaching effectiveness, personalize student learning, and streamline faculty workload. The wide usage of AI tools in the classroom elucidates the importance of understanding the significant variables to know how key knowledge dimensions, Technological Knowledge, Pedagogical Knowledge, and Content Knowledge, influence the success and effectiveness of AI chatbot integration in the classroom. Faculty knowledge and preparedness are significant in the efficient integration of AI tools. We noticed that despite the increased involvement of the AI powered tools, there is very scant research available on how various knowledge dimensions such as Technological Knowledge, Pedagogical Knowledge, Content Knowledge, Pedagogical Content Knowledge, Technological Pedagogical Knowledge, Technological Content Knowledge, Technology Acceptance Model, Constructivist Learning Theory, and Human-Technology Synergy affect the integration of AI chatbots into educational environments. Most research focuses on the broader scope of technological adoption without exploring the roles of faculty knowledge areas and their interactions. This gap in the literature calls for more focused studies to explore how these factors contribute to successful AI integration in the education environment. With AI's revolutionary effect on teaching and learning, faculty members must possess the skills and ability to successfully integrate AI chatbots and use them effectively in their classrooms. This study aims to investigate the relationship between various dimensions of faculty knowledge, namely, Technological Knowledge, Pedagogical Knowledge, Content Knowledge, Pedagogical Content Knowledge, Technological Pedagogical Knowledge, Technological Content Knowledge, Technology Acceptance Model, Constructivist Learning Theory, and Human-Technology Synergy and their influence on the effectiveness of AI chatbot integration in educational settings. Our research focuses on how knowledge constructs contribute to faculty success around teaching effectiveness, workload management, and the overall integration and adoption of AI tools in enhancing the quality of teaching and learning.

LITERATURE REVIEW

AI chatbots in education enhance teaching effectiveness, student engagement and administrative tasks. They are becoming a valuable part of modern education systems by offering personalized learning, improving communication, and providing instant feedback (Labadze et al., 2023)These chatbots use natural language processing to understand and create human-like interactions, which helps to enhance the learning experience for the learners (Alqahtani et al., 2023). The study of (D. R. Mishra & Varshney, 2024) explored the division of duties between AI and educators. The study underscored the capabilities of AI tools to systematize teaching functions such as grading, content delivery, and student interaction, which has opened new opportunities for educators to focus on pedagogical strategies while the technology handles routine tasks.

AI chatbot integration requires educators to understand different dimensions of knowledge. According to (P. Mishra & Koehler, 2006) the Technological Pedagogical Content Knowledge (TPACK) framework, for this educator need to combine Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) to use educational technology successfully. While technological proficiency allows educators to use AI tools, pedagogical knowledge will ensure that teaching practices meet student learning needs. Furthermore, content knowledge ensures that AI tools align with the subject matter being taught, and they should provide accurate and relevant content. The Technological Pedagogical Content Knowledge (TPCK) framework underlines the

intersection of technology, pedagogy, and content knowledge, highlighting the importance of using technology to enhance teaching effectiveness. The primary benefit of incorporating technology in teaching lies in its ability to engage students through visual representations and virtual learning methods, which facilitate conceptual understanding. For this reason, pedagogical content knowledge (PCK) plays a crucial role. According to (Mahato & Sen, 2023)PCK refers to the specialized knowledge teachers develop over time to teach content in ways that enhance student comprehension. PCK is distinct from merely delivering subject knowledge, as it integrates teaching strategies, content expertise, and pedagogical techniques tailored to the teaching context, content, and teacher experience (Loughran, 2020). While PCK is foundational for teaching proficiency, it varies among educators, reflecting individual teaching styles and strategies(D. R. Mishra & Varshney, 2024). Moreover, Technological Pedagogical Knowledge (TPK), a subcomponent of TPCK, emphasizes the knowledge required to integrate technology effectively into teaching practices. The development of TPK in educators significantly impacts their ability to use AI chatbots effectively in the classroom. Similarly, Technological Content Knowledge (TCK) emphasizes the importance of applying technology in specific content areas. Educators must not only be proficient in the use of technology but also know how to apply it to the subject matter they teach. Thus, the success of AI chatbot integration depends on the educator's ability to combine their technological expertise with content-specific knowledge.

The emergence of conversational Chatbots, designed for text or speech interactions, transforms education by assisting faculty and engaging students. In higher education, they simplify administrative tasks, provide personalized learning support, and enhance communication between educators and learners. As institutions modernize and want to take the world ranking, HEI must be updated. The chatbots are essential for bridging gaps in traditional teaching methods and fostering a more responsive, student-centered approach to education (Traymbak et al., 2024). Like every coin has two sides, every perspective has both positive and negative sides. Hence, the pitfall for AI-based tools sometimes gives output biases, particularly in automated grading and feedback mechanisms, if the underlying algorithms are not carefully designed (Ragolane & Patel, 2025)TAM has been used in education to examine how students and faculty interact with digital learning tools, such as AI chatbots.

The Technology Acceptance Model (TAM), which explores the factors influencing user's acceptance of technology, shows that the success of AI tools also reflects on faculty member's attitudes and beliefs about technology(Davis, 1989). Teacher's Their perceptions of AI tools, whether they view them as helpful or unpleasant, affect their enthusiasm for integrating these tools into their teaching practices. (Venkatesh & Davis, 2000) and (Gefen & Straub, 2000) their work shows that perceived ease of use and usefulness are critical predictors of technology acceptance and user satisfaction. New AI tools such as Teacher-Bots (T-bots) are integrated into learning management systems, and aligning technology with pedagogy and content is essential to optimize learning outcomes. Among the various technological innovations in education, AI-driven tools such as Teacher-Bots are becoming increasingly popular because they provide personalized learning experiences and support teachers in managing administrative tasks. The Technology Acceptance Model (TAM) has been widely adopted to understand the factors influencing the acceptance and usage of AI technologies in education, with perceived ease of use and perceived usefulness being the two primary constructs affecting adoption (Pillai et al., 2024). Moreover, integrating AI into teaching requires an understanding of Constructivist Learning Theory (CLT), which emphasizes the role of active student engagement in learning (Sjøberg, 2010)(Chuang, 2021). AI chatbots must, therefore, function as efficient tools for delivering content and fostering meaningful interactions that support student learning outcomes. Chatbots in education align with constructivist principles by facilitating meaningful, real-time interactions between students and teachers. These tools support dynamic, context-driven conversations, enabling active learning.

Artificial intelligence application in education increasingly focuses on collaboration between human educators and AI tools. AR and VR characterize this shift in the augmented and virtual reality perspective**,** which sees AI as a tool to support and enhance human teaching abilities rather than

replace them (O'Brien, 2024). AI chatbots also benefit from contextual integration, wherein the system retains and applies knowledge from previous interactions to improve the user experience. This ability to engage in dynamic, ongoing conversations is crucial for ensuring meaningful student-teacher and student-chatbot interactions (Okonkwo & Ade-Ibijola, 2021). By improving data collection and analysis and providing personalized insights, AI plays a pivotal role in enhancing teaching effectiveness and learning outcomes (Vashishth et al., 2024). AI integration in education requires collaboration between human educators and technological tools, such as Human-Technology Synergy (HTS), which is the concept of hybrid intelligence**,** where both elements complement each other to achieve optimal outcomes rather than being seen as a substitute for teachers (Kim, 2024). AI tools like chatbots are designed to optimize educational processes, assist in understanding student behaviors, and improve learning outcomes (Abdallah et al., 2024). Considering the critical role of these knowledge dimensions, the following hypotheses are formulated for this study:

H_{01}: Technological knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.

H_{02}: Pedagogical knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.

H_{03}:Content knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.

H_{04}: Pedagogical content knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.

H_{05}: Technological pedagogical knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.

H_{06}: Technological content knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.

H_{07}: The Technology acceptance model could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.

H_{08}: Constructivist learning theory could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.

H_{09}:Human technology synergy could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.

Table1: Summary of Literature Reviewed

No.	Focus Area	Literature review study
1	Task distribution between AI and Educator	(Alqahtani et al., 2023; Labadze et al., 2023; D. R. Mishra & Varshney, 2024)
3	TPACK, TK, CK, TPK, PCK in AI adoption	(Loughran, 2020; Mahato & Sen, 2023; P. Mishra & Koehler, 2006)
4	Technology Acceptance Model	(Davis, 1989; Pillai et al., 2024; Venkatesh & Davis, 2000)
5	Constructivist Learning Theory	(Chuang, 2021; Sjøberg, 2010)
6	Human-technology synergy	(Eltahir & Abdallah, 2019; Okonkwo & Ade-Ibijola, 2021)
7	Hybrid intelligence in education	(Kim, 2024; O'Brien, 2024)

Source: Made by Authors (2024)

The focus area of the literature reviewed is summarised in Table 1, providing the base for the conceptual framework to work further on the study. The conceptual framework outlines the relationships between the independent variables Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Technological

Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Technology Acceptance Model (TAM), Constructivist Learning Theory (CLT), Human-Technology Synergy (HTS) and the dependent variable, Effectiveness of AI Chatbot Integration. The framework hypothesizes that faculty with higher levels of Technological, Pedagogical, and Content Knowledge will be more successful in integrating AI tools effectively, leading to improved teaching effectiveness and enhanced student learning outcomes. Fig 1 will guide the study in examining how these knowledge areas influence the integration of AI chatbots into teaching practices.

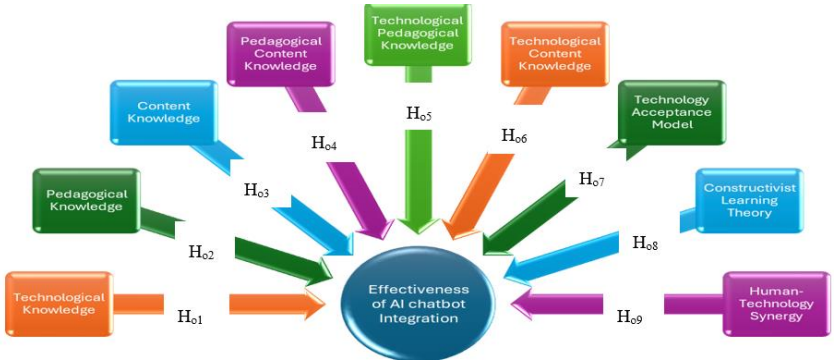

Fig1: Conceptual Framework for the study

Source: Independent variable taken from (Eltahir & Abdallah, 2019)P. Mishra & Koehler (2006),(Venkatesh & Davis, 2000),(Sjøberg, 2010) and dependent variable from (Kim, 2024; O'Brien, 2024)

RESEARCH METHOD

Our study used the quantitative research design to investigate the relationship between faculty knowledge dimensions and the effectiveness of AI chatbot integration in teaching practices. The minimum sample size required for the study is calculated using Cohen's Power Analysis. Considering the anticipated medium effect size (R^2=0.25), a power of 80% (1−β), and a significance level (α=0.05), the required sample size is calculated as follows:

$$N = \frac{8}{(0.25)^2} + 50$$

$$= \frac{8}{0.0625} + 50$$

$$= 128 + 50$$

$$= 178$$

To avoid the issues such as incomplete responses and outliers, the sample size was increased to 254 participants. This adjustment ensures sufficient power to detect meaningful effects while maintaining statistical reliability. We have surveyed 254 educators from India, Oman and Kenya about their experience with AI in the classrooms. The respondents represent faculty from various departments at all career stages. The data collection process utilized a structured questionnaire administered and circulated through the snowball sampling method. Snowball sampling is a non-probability technique where initial respondents recruit additional participants from their networks. This approach was particularly effective for reaching a dispersed population of faculty members across departments, ensuring broad participation and representation. The method also allowed the study to efficiently access participants who might not have been reachable through conventional sampling techniques. The relationship between the dependent variable and independent variables will be analyzed using the following regression model:

$$AICI = \beta_0 + \beta_1(TK) + \beta_2(PK) + \beta_3(CK) + \beta_4(PCK) + \beta_5(TPK) + \beta_6(TCK) + \beta_7(TAM) + \beta_8(CLT) + \beta_9(HTS) + \varepsilon$$

Where:

AICI= Effectiveness of AI Chatbot Integration (DV)

TK = Technological Knowledge (IV)

PK = Pedagogical Knowledge (IV)

CK = Content Knowledge (IV)

PCK = Pedagogical Content Knowledge (IV)

TPK = Technological Pedagogical Knowledge (IV)

TCK = Technological Content Knowledge (IV)

TAM = Technology Acceptance Model (IV)

CLT = Constructivist Learning Theory (IV)

HTS = Human-Technology Synergy (IV)

$_0$ = Intercept (constant term)

β_1, β_2, ..., β_9 = Coefficients for each independent variable, representing the weight of each variable in predicting the dependent variable.

ε = Error term (residual), representing the unexplained variance in the dependent variable.

RESULT AND DISCUSSION

Table 2: Descriptive Statistics

Demographic Variable	Category	Frequency	Percentage
Gender	Male	141	55.5%
	Female	113	44.5%
	Total	254	100%
Qualification	Bachelor	55	21.7%
	Master	112	44.1%
	PhD	87	34.3%
	Total	254	100%
Specialization	Information Technology	35	13.8%
	Computer Science	30	11.8%
	Mechanical	16	6.3%
	Electrical	4	1.6%
	Electronics	19	7.5%
	Civil & Architecture	27	10.6%
	Applied Science	37	14.6%
	Physics	17	6.7%
	Biology	13	5.1%
	Mathematics	13	5.1%
	Business Studies	43	16.9%
	Total	254	100%
Experience	1-2 years	35	13.8%
	3-4 years	30	11.8%

Demographic Variable	Category	Frequency	Percentage
	5-6 years	16	6.3%
	7-8 years	4	1.6%
	9-10 years	19	7.5%
	11-12 years	27	10.6%
	13-14 years	37	14.6%
	More than 15 years	43	16.9%
	Total	254	100%

Source: Made by Authors from field data by SPSS 30 (2024)

Table 2 shows the data of 254 participants, 55.5% male and 44.5% female. The educational qualifications of the sample were 21.7% bachelor's degree, 44.1% master's degree, and 34.3% PhD. For the specialization, 16.9% were in Business Studies, followed by Applied Science 14.6% and Information Technology 13.8%. The details of the work experience show that 13.8% of participants had 1-2 years of experience, while 16.9% had more than 15 years.

The data, with a sample size of 254 participants of the given demography, genders, educational backgrounds, and experience levels, ensures the strength and reliability of the data for further analysis.

Table 3: Reliability Analysis

Variable name	Constructs	Cronbach's alpha
Technological Knowledge (TK)	4	0.878
Pedagogical Knowledge (PK)	4	0.857
Content Knowledge (CK)	4	0.800
Pedagogical Content Knowledge (PCK)	5	0.930
Technological Pedagogical Knowledge (TPK)	4	0.864
Technological Content Knowledge (TCK)	4	0.903
Technology Acceptance Model (TAM)	4	0.833
Constructivist Learning Theory (CLT)	4	0.856
Human-Technology Synergy (HTS)	4	0.869
Effectiveness of AI Chatbot Integration(AICI)	4	0.858

Source: Made by Authors from field data by SPSS 30 (2024)

Table 3 shows that all constructs had Cronbach's Alpha values ranging from 0.800 to 0.930, an acceptable reliability. These values suggest that the constructs measured in this study are internally consistent and appropriate for further analysis.

Table 4: Model Summary[b]

Model	R				Change Statistics	

		R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.889[a]	.790	.782	1.37997	.790	102.134	9	244	<.001	1.917
a. Predictors: HTS, TK, TPK, CK, CLT, PK, TAM, TCK, PCK b. Dependent Variable: AICI										
Source: Made by Authors from field data by SPSS 30 (2024)										

The Model Summary in Table 4 presents the overall fit of the linear regression model. The R value of 0.889 suggests a strong positive relationship between the independent variables (TK, PK, CK, PCK, TPK, TCK, TAM, CLT, HTS) and the dependent variable, the Effectiveness of AI Chatbot Integration (AICI). The R^2 value of 0.790 indicates that approximately 79% of the variance in the effectiveness of AI chatbot integration is explained by the independent variables included in the model. This reflects that the factors measured in the study strongly influence the effectiveness of AI chatbot integration in an educational environment. The Adjusted R^2 value of 0.782 further supports the model's strength, accounting for the number of predictors. The Standard Error of the Estimate reported as 1.37997, indicates that the predicted values from the model are relatively close to the observed values, suggesting a good model fit. Additionally, the Durbin-Watson statistic 1.917 falls within the acceptable range of 1.5 to 2.5, confirming no significant autocorrelation in the residuals(Turner, 2020).

Table 5: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1750.455	9	194.495	102.134	<.001[b]
	Residual	464.651	244	1.904		
	Total	2215.106	253			
a. Dependent Variable: AICI, b. Predictors: HTS, TK, TPK, CK, CLT, PK, TAM, TCK, PCK						
Source: Made by Authors from field data by SPSS 30 (2024)						

The ANOVA results presented in Table 5 test the overall significance of the regression model. The F statistic of 102.134 with df = 9, 244 and a p-value < 0.001 shows that the model is statistically significant. This means that the independent variables collectively explain significant variance in the dependent variable, the Effectiveness of AI Chatbot Integration.

Table 6: Coefficients[a]

Model		**Unstandardized Coefficients**		**Standardized Coefficients**		
		B	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	1.461	.590		2.477	.014
	TK	.217	.057	.246	3.845	<.001
	PK	.125	.065	.137	1.935	.054
	CK	-.185	.064	-.175	-2.913	.004
	PCK	.058	.067	.068	.872	.384
	TPK	.002	.060	.003	.040	.968
	TCK	-.030	.068	-.033	-.438	.662
	TAM	.253	.069	.251	3.662	<.001
	CLT	.225	.060	.226	3.722	<.001
	HTS	.249	.056	.243	4.437	<.001

a. Dependent Variable: AICI
b. Source: Made by Authors from field data by SPSS 30 (2024)

From Table 6 The Coefficients table provides the significance levels for each independent variable. Technological Knowledge (TK): B = 0.217, Beta = 0.246, p < 0.001. Since p < 0.05, we reject H_{01} and

conclude that there is a significant positive relationship between Technological Knowledge (TK) and the effectiveness of AI chatbot integration. Pedagogical Knowledge (PK): B = 0.125, Beta = 0.137, p = 0.054. Since p > 0.05, we fail to reject H_{02}, meaning Pedagogical Knowledge (PK) does not significantly affect AI chatbot integration, although the value is marginally close to significance. Content Knowledge (CK): B = -0.185, Beta = -0.175, p = 0.004. Since p < 0.05, we reject H_{03} and conclude that there is a significant negative relationship between Content Knowledge (CK) and the effectiveness of AI chatbot integration. Pedagogical Content Knowledge (PCK): B = 0.058, Beta = 0.068, p = 0.384. Since p > 0.05, we fail to reject H_{04}, indicating that Pedagogical Content Knowledge (PCK) does not significantly impact AI chatbot effectiveness. Technological Pedagogical Knowledge (TPK): B = 0.002, Beta = 0.003, p = 0.968. Since p > 0.05, we fail to reject H_{05}, indicating that Technological Pedagogical Knowledge (TPK) does not significantly predict AI chatbot effectiveness. Technological Content Knowledge (TCK): B = -0.030, Beta = -0.033, p = 0.662. Since p > 0.05, we fail to reject H_{06}, indicating that Technological Content Knowledge (TCK) does not significantly influence AI chatbot effectiveness. Technology Acceptance Model (TAM): B = 0.253, Beta = 0.251, p < 0.001. Since p < 0.05, we reject H_{07} and conclude that the Technology Acceptance Model (TAM) significantly positively affects the effectiveness of AI chatbot integration, suggesting that higher faculty acceptance of AI tools leads to better chatbot integration. Constructivist Learning Theory (CLT): B = 0.225, Beta = 0.226, p < 0.001. Since p < 0.05, we reject H_{08} and conclude that Constructivist Learning Theory (CLT) is significantly positively related to the effectiveness of AI chatbot integration. This underscores the need to align teaching strategies with constructivist principles to increase the efficiency of AI tools in education. Human-Technology Synergy (HTS): B = 0.249, Beta = 0.243, p < 0.001. Since p < 0.05, we reject H_{09} and conclude that Human-Technology Synergy (HTS) has a significant positive relationship with the effectiveness of AI chatbot integration. Faculty who show stronger synergy with technology tend to perceive AI chatbots as more effective in teaching. The result of the hypothesis testing is summarised in Table 7.

Table 7: The result of the Hypothesis

No.	Null Hypothesis	Results
	Technological knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.	Rejected
	Pedagogical knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.	Accepted
	Content knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.	Rejected
	Pedagogical content knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.	Accepted
	Technological pedagogical knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.	Accepted
	Technological content knowledge could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.	Accepted
	The Technology acceptance model could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.	Rejected
	Constructivist learning theory could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.	Rejected
	Human technology synergy could not significantly improve the effectiveness of AI chatbot integration in education at the 0.05 level.	Rejected

DISCUSSION

The result of the regression analysis shows strong positive relationships with technology knowledge, the technological acceptance model, constructivist learning theory, and human-technology synergy, which underscores the importance of knowledge dimensions in successfully integrating AI tools into teaching practices. Faculty members who possess higher levels of technological knowledge, accept technology, align their teaching with constructivist principles, and have strong synergy with technology are more likely to perceive AI chatbots as effective. On the other hand, the negative

relationship found with Content Knowledge requires more exploration to see why faculty with higher CK view AI chatbots as less effective. Similarly, Pedagogical Content Knowledge and Technological Pedagogical Knowledge did not significantly influence AI chatbot effectiveness. The analysis reflects that faculty with higher content knowledge consider AI chatbots less effective because they are more likely to rely on their expertise and knowledge. Moreover, there is an algorithmic bias issue of trust and a lack of clear guidelines about AI usage, inhibiting their technology usage. These findings give the direction for future research to understand the reason for content knowledge, technological pedagogical knowledge, and pedagogical content knowledge and their relation to AI integration in the education sector regarding demography. The findings of this study underscore the importance of training the faculty with technological knowledge and promoting positive attitudes towards technology to maximize the effectiveness of AI chatbots in higher education.

Conclusion and Practical Implication

The study found that the successful integration of AI chatbots in the educational environment is influenced by the faculty's Technological Knowledge, as indicated by the Technology Acceptance Model, and their ability to collaborate effectively with technology through Human-Technology Synergy. Results of the study show that using the constructivist learning theory is adequate for AI chatbot tools in the classroom. AI chatbots improve teaching efficiency, optimize workload management, and enhance student learning experiences. Therefore, educational institutions should provide faculty development programs to ensure faculty members are well-equipped to utilize AI chatbots in their teaching practices. The practical implications of our study underscore the importance of training educators with the skills and knowledge to integrate AI chatbots into their teaching practices effectively by creating an environment where teachers and technology can collaborate effectively by developing systems that promote human-human-technology synergy. This will confirm that AI chatbots complement and enhance, rather than replace, traditional teaching methods.

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