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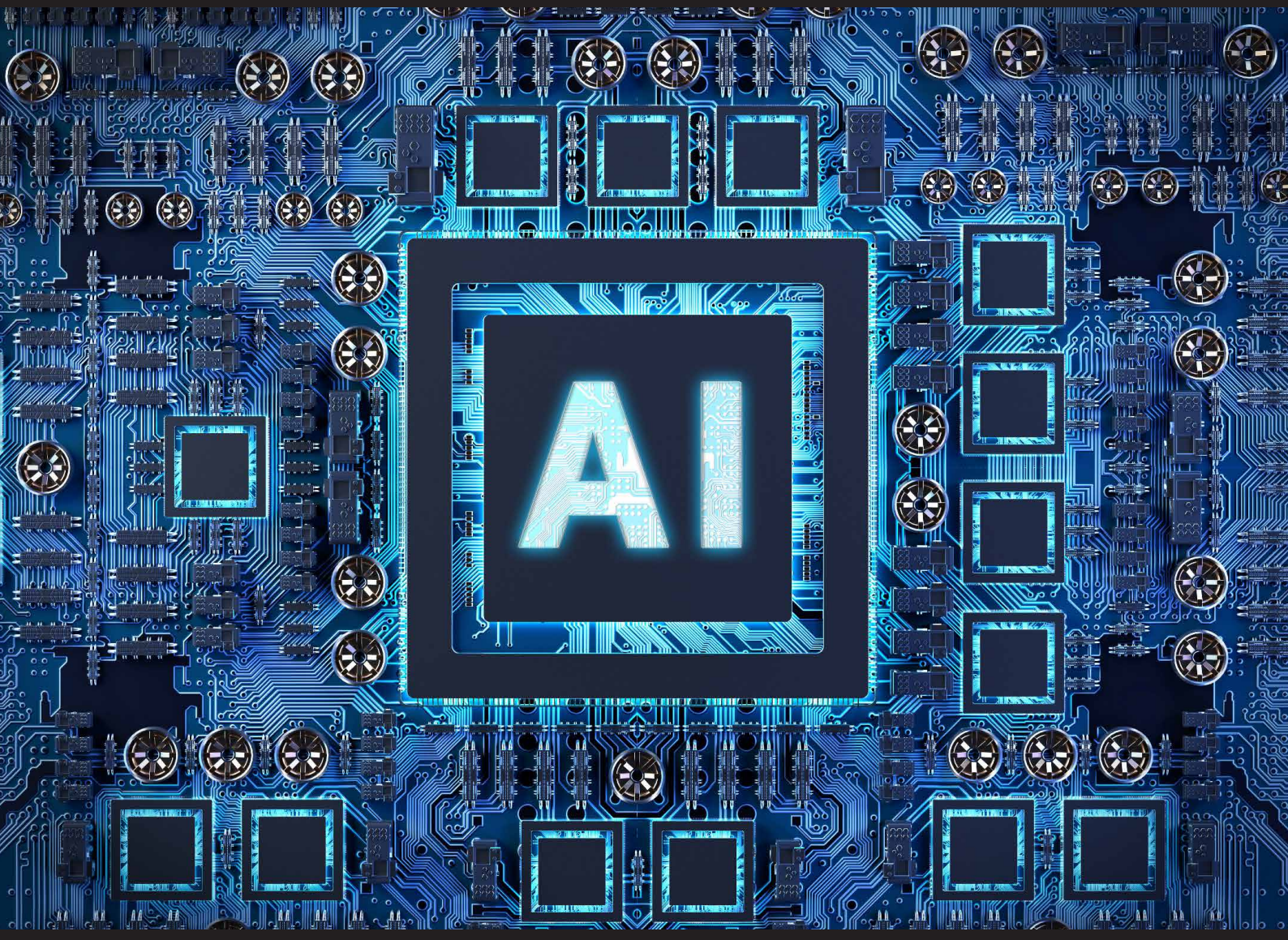
journal of education technology in education

Volume 11 – Issue 2 – 2023

Editor: Michael P. Menchaca



ISSN: 2187-0594

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IAFOR Journal of Education: Language Learning in Education
Volume 11 – Issue 2 – 2023

IAFOR Publications

The International Academic Forum

IAFOR Journal of Education: Technology in Education

Published by The International Academic Forum (IAFOR), Japan
IAFOR Publications, Sakae 1-16-26-201, Naka-ward, Aichi, Japan 460-0008

IAFOR Journals Administrator: Mark Kenneth Camiling
Publications Manager: Nick Potts

IAFOR Journal of Education: Technology in Education
Volume 11– Issue 2 – 2023

Published August, 2023

ISSN: 2187-0594

ije.iafor.org

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Edited by Michael P. Menchaca

Associate Editor: Daniel L. Hoffman

Associate Editor: Devayani Tirthali

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From the Editors

Another year, another opportunity to explore the complex relationships between technology, teaching, and learning. And what a year it was! Propelled by lessons learned from the COVID-19 pandemic, researchers and practitioners from around the world continue to wrestle with important matters related to online and blended learning, the emergence of generative artificial intelligence (AI), and how we scaffold and support learners and teachers. How should we make sense of this ever-changing educational landscape? In some ways, it seems our efforts to answer this question (and others) feel more pressing and important than ever.

As in year's past, the current issue of the IAFOR Journal of Education is proud to share five articles with readers. Each article probes the possibilities and implications of today's educational technologies in their own way and with different target populations. They explore a range of topics including AI chatbots, virtual simulations, technology integration, and collaborative and remote education. Together these manuscripts continue the journal's ongoing commitment to international scholarship with authors from India, Morocco, South Africa, Sweden, and Qatar.

What follows is a quick overview of the articles in this year's technology-focused issue.

The first article is interested in university students' perceptions of AI chatbots. Do chatbots have a place in higher education? And, if so, where? In this article, Antony and Ramnath begin by defining chatbots and then elaborating on their surprisingly long history. From there, they describe a qualitative study aimed at understanding the factors that influence student engagement and support with AI chatbots. Guided by the Unified Theory of Acceptance and Use of Technology, the authors share eight themes revealing the potential of "virtual assistants" to facilitate communication, enhance engagement, and offer timely support.

Our second article offers readers a South African perspective on what higher education might learn about remote learning in the wake of COVID-19. Authored by Pitso, this article describes a study that used participatory evaluation design to develop a deeper understanding of remote learning as the "new normal" and to explore its advanced potentialities. Working with undergraduates (n = 15), the paper promotes a "technology-as-essence" framework, arguing that remote learning can, and should, lead to greater student control of the learning process. The study addresses the positive impact asynchronous learning models coupled with advanced technologies can have on institutions of higher education.

The third article by Hansson, Samuelsson, and Höög explores the impact of using virtual simulations to help pre-service teachers feel more comfortable teaching controversial issues. Using conspiracy theories as controversial issues, the authors worked with student teachers (n = 43) in Sweden who were tasked with teaching these theories and critical thinking to virtual learners in a simulation. The purpose was to create a safe and authentic training situation for preservice teachers to improve their practice. The results support existing evidence that

simulation teaching is a cost-effective and powerful way to provide student teachers experiences that help them integrate different forms of knowledge (e.g., content, pedagogical).

The fourth article by Baytar, Ettourouri, Saqri, and Ouchaouka examines Moroccan teachers' concerns about integrating information and communications technology into their teaching practices. The study used the Concerns-Based Adoption Model with 382 teachers to generate an overall profile of the teachers' stages of concern. The results found many teachers fit a profile of "reluctant" non-users. However, the findings highlighted important relationships between the teachers' concerns about technology integration, their technology training, and their pandemic experience. Taken together, these findings have important implications for the design of interventions meant to address teachers' individual technology integration concerns.

The final article in this issue is a conceptual piece encouraging readers to think about today's educational technology trends and teaching requirements. It challenges all of us to think about what these suggest about the future of the education enterprise. With these big ideas established, the authors argue that *collaboration* should be a central component of how learners acquire digital skills in an era of AI. They go on to make the case that advanced educational technologies can be integrated with engaging pedagogical approaches to make it easier than ever for students and teachers to interact and engage collaboratively.

In closing, we hope you find the articles in the current issue enlightening and inspiring as the field continues its earnest efforts to make high-quality and meaningful education the standard for all.

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A Phenomenological Exploration of Students' Perceptions of AI Chatbots in Higher Education

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Article 2:
Post-COVID-19 Higher Learning: Towards Telagogy, A Web-Based Learning Experience

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Article 3:
Teaching Avatars on Controversial Issues: Lessons Learned

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Article 4:
Moroccan Teachers' Perceptions and Concerns about ICT Integration

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Article 5:
Rethinking Education: An In-Depth Examination of Modern Technologies and Pedagogic Recommendations

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A Phenomenological Exploration of Students' Perceptions of AI Chatbots in Higher Education

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Abstract

This study examines the impact of AI chatbots as a communication medium on student engagement and support in higher education. The qualitative method and Interpretative Phenomenological Analysis (IPA) were employed as the research approach, utilizing in-depth semi-structured interviews. Purposive sampling was used to select 11 participants from the state of Kerala, India, in higher education. Data analysis followed the Systematic Text Consideration (STC), a five-step process, including framing meaning units, condensing meaning units, coding, creating sub-themes, and deriving themes. By exploring themes aligned with the UTAUT2 constructs, a comprehensive understanding of the factors influencing student engagement and support was achieved. A total of eight themes were identified, encompassing "Effectiveness and Limitations," "Beyond," "Enrichment," "Optimization," "Synergize," "Streamlining Communication," "Engage+AI," and "Refine." These themes provided compelling evidence of the transformative potential of AI chatbots in facilitating effective communication, enhancing engagement, and offering timely support. The study's results carry significant practical implications for higher education institutions. Embracing AI chatbots, universities and institutions can enhance student engagement and support through efficient communication, personalized recommendations, and streamlined interactions. These chatbots offer a balance between quick assistance and human expertise, optimizing both routine tasks and complex inquiries. Additionally, addressing security and privacy concerns is crucial to fostering trust and successful integration. Overall, embracing AI chatbots can transform the educational experience, making it more efficient, engaging, and supportive for students in higher education.

Keywords: chatbots, AI chatbots, higher education, Interpretative Phenomenological Analysis, UTAUT2

In contemporary society, the pervasive presence of chatbot technology is evident across various domains, ranging from smart home speakers to workplace messaging applications. These advanced Artificial Intelligence (AI) chatbots, often denoted as "virtual assistants" or "virtual agents," can operate through diverse mediums. They can be engaged through audio input, as exemplified by Apple's Siri, Google Assistant, and Amazon Alexa, or facilitate interactions via text-based platforms such as SMS, ChatGPT, and Google Bard. This accessibility empowers individuals to engage in natural conversations with chatbots, eliciting information and refining inquiries through interactive responses and follow-up interactions. Amid the rising prominence of AI technologies, attention has shifted towards their potential to elevate student engagement and support within higher education. A specific application of AI that showcases substantial promise is AI chatbot communication. AI chatbots offer personalized and prompt assistance, enabling students to efficiently access information and resources. However, the effective implementation of AI chatbots in higher education necessitates a profound understanding of how students perceive and interact with such communication tools. The integration of AI chatbots into higher education has gained considerable traction as a mechanism to enhance student engagement and academic achievement (Pérez et al., 2020; Studente et al., 2020). The literature demonstrates an increasing interest in leveraging chatbots to deliver efficient services to students (Pérez et al., 2020) while concurrently bolstering their engagement (Studente et al., 2020). These trends underline the broader acknowledgment of AI chatbots' potential in education, fostering personalized support and facilitating interactive and responsive learning experiences. Moreover, students perceived chatbots and instant-messaging services as valuable for communicating with course directors and obtaining necessary support (Abbas et al., 2022).

This research is guided by two main research questions. These questions delve into students' perceptions and preferences regarding AI chatbots in higher education: RQ1: How do students perceive the role of AI chatbots in enhancing student engagement and support in higher education? What factors contribute to their opinions about the helpfulness and effectiveness of AI chatbots communication? RQ2: What key factors influence students' preferences for using AI chatbots as a means of communication in higher education? How do concerns about security, privacy, and other factors impact their decision to adopt AI chatbots for addressing inquiries related to admissions, courses, academics, and library references? The first question scrutinizes students' perspectives on AI chatbots in higher education, specifically examining their contributions to student engagement and support. It aims to unearth the factors shaping students' views on the effectiveness and utility of communicating with AI chatbots in educational contexts. This understanding is paramount for educational institutions to glean insights into the advantages and limitations of incorporating chatbot technology, optimizing both student engagement and support. The second question focuses on the factors influencing students' inclination towards using AI chatbots for communication in higher education. As AI chatbots continue their ascendancy, comprehending students' perspectives becomes pivotal for their effective integration and alignment with students' needs. The significance of this study lies in its potential to enrich the realm of higher education by providing insights into the impact of AI chatbots on student engagement and support. However, it's important to acknowledge that students' perceptions of AI chatbots can vary, and concerns encompassing privacy,

reliability, and impersonal interactions have emerged. In bridging these research gaps, this study employs qualitative interpretive phenomenology (Smith et al., 2009) to delve into students' experiences, perceptions, and attitudes, when interacting with AI chatbots in higher education. Through the analysis of interview transcripts, this research aims to unveil the sophisticated factors that influence students' perceptions, experiences, and attitudes towards AI chatbots. These findings will offer valuable insights to guide the design and implementation of AI chatbots, optimizing their potential to amplify student engagement and support in higher education.

The structure of this paper is organized as follows: Commencing with a succinct overview of the historical evolution of chatbots, emphasizing their relevance in higher education, the subsequent section embarks on a comprehensive literature review. This review encapsulates the existing research on AI chatbots in higher education, traversing their potential advantages and attendant concerns. Additionally, the theoretical framework underpinning this study, the Unified Theory of Acceptance and Use of Technology (UTAUT2), is introduced (Venkatesh et al., 2003, 2012). The methodology section delineates the research design, participant selection process, interview procedures, ethical considerations, and the qualitative data analysis approach Systematic Text Condensation (STC). The results and discussion sections encapsulate the emergent themes and codes drawn from students' experiences and perceptions of AI chatbot communication within higher education. These themes are compiled with the UTAUT2 model constructs. Ultimately, the conclusion synthesizes key findings, acknowledges the study's limitations, and furnishes recommendations to optimize AI chatbots' deployment for enhancing students' engagement and support. This study aspires to augment current understanding of AI chatbot communication within higher education through an in-depth exploration of the student experience. Through this exploration of students' perceptions, attitudes, and lived experienced, this research yields valuable insights into the potential impact of AI chatbots on student engagement and support. These insights will pave the way for the formulation of effective strategies and guidelines for the seamless integration of AI chatbots, ultimately enhancing the educational experience and academic attainment of university students.

Review of Literature

This literature review encompasses three main areas: the history of chatbots, AI chatbots used in education, and AI chatbots as a communication medium in higher education. It explores the existing literature and empirical evidence surrounding these topics, as well as sorts out the potential benefits and concerns associated with the use of AI chatbots in educational settings.

History of Chatbots

A chatbot is a computer program that engages in text or voice-based interactions, simulating human-like conversation and comprehending multiple human languages through the application of Natural Language Processing (NLP) (Khanna et al., 2015). According to Lexico Dictionaries, a chatbot is described as "A computer program designed to simulate conversation

with human users, especially over the Internet." These versatile entities are also recognized by various terms, including smart bots, interactive agents, digital assistants, or artificial conversation entities. The concept of chatbots dates to the mid-20th century when Alan Turing proposed the Turing test to evaluate machine intelligence (Turing, 1950). In 1966, the Massachusetts Institute of Technology (MIT) developed the first known chatbot called ELIZA, which used a pattern matching rule system to generate responses based on specific keywords (Mekni et al., 2020). ELIZA simulated a non-directional psychotherapist and employed template-based responses (Mekni et al., 2020). Another significant chatbot was PARRY, which was developed in 1972 and simulated a patient with schizophrenia (Colby et al., 1972). PARRY exhibited a personality and responded based on assumptions and emotional reactions triggered by user input (Colby et al., 1972). Artificial Intelligence (AI) entered the chatbot domain with the creation of Jabberwacky in 1988. This chatbot utilized Clever Script and contextual pattern matching. The term "Chatterbot" was first used in 1991 to refer to an artificial player in the TINYMUD virtual world (Mauldin, 1994). In 1995, Wallace introduced the Artificial Linguistic Internet Computer Entity (A.L.I.C.E) architecture, which distinctly separates the "chatbot engine" and the "language knowledge model." This separation allowed for the seamless integration of different language knowledge models providing a plug-and-play capability (AbuShawar & Atwell, 2015). A.L.I.C.E gained popularity in 2001, utilizing the Artificial Intelligence Mark-up Language (AIML) and featuring a substantial knowledge base. Advancements in NLP and AI technologies led to the emergence of rule-based chatbots like A.L.I.C.E. in the 1990s (Powton, 2018; Dale, 2016).

In 2001, SmarterChild revolutionized chatbots technology by providing practical assistance to users by retrieving information from databases (Molnár & Zoltán, 2018). In more recent years, voice-activated personal assistants like Siri, Watson Assistant, Google Assistant, Cortana, and Alexa gained popularity for managing tasks and engaging in conversation (Powton, 2018; Dale, 2016). Social media platforms facilitated the development of chatbots for various purposes, and by the end of 2016, around 34,000 chatbots existed across different fields (Powton, 2018). Integrating chatbots with the Internet of Things (IoT) improved communication between connected smart objects (Kar & Haldar, 2016). Generative Pre-trained Transformers (GPT) are advanced neural network models with a transformer architecture, revolutionizing AI for tasks like ChatGPT. These models create human-like text, images, and music, excelling in Q&A, summarization, content creation, and search across industries. The GPT series includes GPT-1 (2018), GPT-2 (2019), GPT-3 (2020), and GPT-3.5 (2022), each with enhanced capabilities. GPT-4 (2023) further expands with text prediction and reinforcement learning from human feedback, accepting text and images (Vincent, 2019; Tom et al., 2020).

AI Chatbots in Education

An AI chatbot, also referred to as a virtual assistant or virtual agent, is a sophisticated computer program specifically designed to take advantage of AI and advanced NLP techniques. Its primary function is to understand and interpret customer queries, and subsequently provide relevant and contextually accurate responses. By mimicking human conversation patterns, an AI chatbot engages in interactive and dynamic dialogues, offering effective communication

and assistance to users. These advanced chatbots can engage in conversations through text or voice, and they are designed to interact with users in a conversational manner, similar to how a human would communicate (Caldarini et al., 2022). Powered by machine learning and natural language processing, AI chatbots are capable of learning from interactions and adapting their responses over time (Google AI, 2022). In the past, chatbots were primarily text-based and programmed to provide answers to specific questions predetermined by developers, functioning as interactive FAQs. However, modern AI chatbots go beyond this limitation, maintaining dynamic conversations, and handling complex queries by utilizing deep learning and natural language processing techniques. These chatbots serve various applications, including customer service, information retrieval, and assisting users in a conversational manner (Russell & Norvig, 2010). AI chatbots serve as intelligent software applications that emulate human-like conversations through text or voice interactions, leveraging AI technologies to enhance user engagement and provide accurate and contextually relevant responses (Caldarini et al., 2022; Google AI, 2022; Russell & Norvig, 2010).

The application of AI in the field of education is expanding drastically. Chatbot systems stand out among the prevalent AI technologies used to support teaching and learning (Okonkwo & Ade-Ibijola, 2020). Evidence that they can enhance student interaction is on the rise (Okonkwo & Ade-Ibijola, 2021). Chatbots are regarded as valuable educational instruments for enhancing the teaching and learning process (Clarizia et al., 2018) in higher education by providing personalized and efficient support to students (Cunningham-Nelson et al., 2019). Given the prevalence of smart phones among students in higher education, chatbot systems can be deployed effectively as mobile web applications to facilitate learning. These chatbots offer instantaneous access to standardised information such as efficient and timely services (Pérez et al., 2020), course content (Cunningham-Nelson et al., 2019), study materials (Okonkwo & Ade-Ibijola, 2021), practice questions and answers (Okonkwo & Ade-Ibijola, 2021; Ranoliya et al., 2017; Sinha et al., 2020),evaluation criteria (Okonkwo & Ade-Ibijola, 2021), assignment due dates, and advice (Ismail & Ade-Ibijola, 2019; Okonkwo & Ade-Ibijola, 2021). They can also help streamline administrative tasks (Studente et al., 2020), provide campus path direction (Mabunda & Ade-Ibijola, 2019; Okonkwo & Ade-Ibijola, 2021) and augment student engagement (Studente et al., 2020). Some institutions also introduce chatbots to alleviate costs associated with student administration (Abbas et al., 2022). By providing such comprehensive support, these systems not only improve student engagement and academic support but also substantially reduce the administrative workload and burden of lecturers, allowing them to concentrate on curriculum advancement as well as research (Cunningham-Nelson et al., 2019). Moreover, AI chatbots can streamline administrative tasks in educational institutions. The integration of chatbots in university admissions processes found that they efficiently handled inquiries related to admissions requirements, deadlines, and application status. This freed administrative staff to focus on more complex tasks (Green & Johnson, 2021). While AI chatbots in education offer numerous benefits, further research is necessary to address ethical considerations, understand their impact on student motivation, and develop more advanced conversational capabilities. Addressing these challenges, educational institutions can leverage the potentials of AI chatbots to create more engaging and efficient learning environments for students (Green & Johnson, 2021).

AI Chatbots as a Communication Medium in Higher Education

AI chatbots have emerged as a promising communication medium in higher education (Kooli, 2023), providing personalized assistance and support to students (Cunningham-Nelson et al., 2019). These chatbots emulate human-like conversations, employing natural language structures (Pham et al., 2018) through text messages on websites or mobile applications, voice-based interactions (Alexa or Siri), or a combination of both (Pereira et al., 2019). Functioning as automated conversational agents, they have gained significant popularity in replicating student service interactions across various domains in higher education (Khan et al., 2019; Wang et al., 2021). Tlili et al. (2023) explored how conversational AI, like ChatGPT, might improve online learning. Due to the engagement and interactivity, students preferred AI chatbots as conversational agents for learning activities. Kuhail et al. (2022) found that chatbots might give students immediate feedback, personalized support, and self-directed learning experiences, increasing engagement and motivation. Based on the study of Studente et al. (2020), it is reported that the usage of chatbots in higher education, notably among first-year students, eased university transitions, increased academic engagement, and encouraged peer connection. Chatbots also helped students contact course directors to seek the required support on time.

Employing chatbots as communication tools, researchers bolster collaboration, enriching information exchange and refining research quality. Chatbots amplify cooperative efforts, streamlining information dissemination and enhancing synergy among researchers (Kooli, 2023). Notably, Kooli (2023) meticulously examined the design and integration of a chatbots, specifically tailored for student-teacher interaction within an online university platform. Remarkably, this chatbot seamlessly aided students in comprehending course content and fulfilling assignments, garnering widespread approval and recognition as an invaluable means of facilitating teacher-student communication. The research highlighted the chatbots' latent capacity to elevate student-teacher interaction, consequently augmenting the broader realm of the learning experience (Dwivedi et al., 2023; Mendoza et al., 2020). This illuminates chatbots' pivotal role as a transformative communication medium, poised to revolutionize collaborative dynamics and learning outcomes (Kooli, 2023). The use of AI chatbots in delivering mental health support has also been shown to effectively reduce student stress levels (Liu et al., 2022). Additionally, AI chatbots have demonstrated value in providing academic advising and counselling services, acting as virtual tutors to offer personalized guidance and feedback.

Implementation of AI chatbots, such as "Laurie" at Georgia State University, has improved student engagement and facilitated peer-to-peer communication (Watson et al., 2022). These chatbots have primarily focused on providing course-related information support, serving as online tutors and reducing teachers' workload (Lee et al., 2020). They can also assist in identifying at-risk indicators among students and offer university-related information support, acting as intelligent assistants to improve university services and reduce labour costs (Mekni et.al. 2020; Touimi et al., 2020; Hien et al., 2018). In addition, AI chatbots can extract information from university knowledge bases and provide assistance with admissions-related queries, supporting the academic admissions process. The integration of AI chatbots as a

communication medium in higher education offers numerous advantages. These intelligent agents can provide quick and accurate responses to student queries, support the delivery of course materials, offer academic advising, and enhance campus engagement. Moreover, they have the potential to reduce the workload of teachers and administrative staff, enabling them to focus on more complex tasks (Lee et al., 2020; & Touimi et al., 2020).

Theoretical Framework

The Unified Theory of Acceptance and Use of Technology 2

The Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) framework developed by Venkatesh et al. (2012) is an extension of the original UTAUT model developed by Venkatesh et al. (2003). UTAUT2 incorporates additional constructs to further enhance the understanding of technology acceptance and usage behavior. It also considers the complex interplay of individual, social, and contextual factors that influence technology adoption. This framework can be applied to investigate the impact of AI chatbots as a communication medium for student engagement and support in higher education. The UTAUT combines eight foundational models, enhancing technology acceptance and understanding (Venkatesh et al., 2003). Evolving from diverse fields' theories, UTAUT casts historical illumination on technology adoption's user intentions (Yu, 2012). The UTAUT framework incorporates core constructs: performance expectancy, effort expectancy, facilitating conditions, and social influence. However, an expanded UTAUT2 version emerged in 2012, integrating three new constructs: hedonic motivation, habit, and price value (Venkatesh et al., 2012). The important constructs of UTAUT2 for the present study are described below.

Performance Expectancy

The Performance Expectancy (PE) construct has been described as the degree to which employing a technology yields benefits in task execution (Venkatesh et al., 2003). Hence, it signifies the extent to which individuals gauge an AI chatbot's potential to amplify performance and productivity. PE encapsulates the anticipated outcome or extrinsic motivation linked with usage. Studies acknowledge the impact of AI chatbot adoption as a communication medium in higher education (Vimalkumar et al., 2021).

Effort Expectancy

Effort Expectancy (EE) is defined as a degree of ease (Venkatesh et al., 2003), which reflects the perceived ease of using chatbots. EE predicts technology adoption in education (Wirtz et al., 2019). The aim of any new technology is a favorable user perception of ease (Venkatesh et al., 2012), where self-confidence in technical competence impacts usage intent. EE gauges user friendliness, convenience, and confidence when interacting with AI chatbots. Ease and minimal cognitive effort influence students' technological intent. EE crucially shapes AI chatbots' adoption, aligning user-friendly interfaces with positive intent (Wirtz et al., 2019; Venkatesh et al., 2012).

Social Influence

Social Influence (SI) is defined as the "extent to which students perceive significant others believe they should use a particular technology" (Venkatesh et al., 2003). SI-driven variable models associate beliefs and behaviour with compliance, internalization, identification (Moriuchi, 2021). Peers, teachers, and institutional norms impact individuals' intentions to use AI chatbots through social influence. Social norms and favourable opinions affect the adoption of AI chatbots in education. According to Venkatesh et al. (2003), social influence is how students view significant others. Moriuchi (2021) explained social influence on technology usage through compliance, internalisation, and identification. They also highlighted the importance of SI in educational technology acceptance.

Facilitating Conditions

Facilitating Conditions (FC) refer to the resources that are accessible for engaging in a particular behaviour (Venkatesh et al., 2003). These resources are associated with acceptance, which is determined through self-assessment (Wang et al., 2021). The presence of a strong support infrastructure is crucial for the effective utilisation of technology, particularly in the case of AI-based tools such as chatbots. The study conducted by Vimalkumar et al. (2021) provided further evidence supporting the significance of facilitating conditions in the adoption of digital voice assistants. The adoption of AI chatbots is influenced by various factors, such as technical support, availability of resources, and institutional policies (Vimalkumar et al., 2021).

Hedonic Motivation

Hedonic Motivation (HM) refers to the inclination towards engaging in technology-related activities purely for the enjoyment they provide, without any explicit utilitarian benefits (Venkatesh et al., 2012). HM utilises enthusiasm and optimism to enhance AI chatbot interactions (Brown & Venkatesh, 2005). The experience of users is influenced by factors such as novelty, interactivity, and entertainment. According to Venkatesh et al. (2012), within the context of higher education, the engagement and motivation of chatbots are stimulated by HM.

Price Value

The concept of Price Value (PV) is used to assess the net benefits derived from technology, as discussed by Venkatesh et al. (2012). Price value pertains to the assessment of cost-effectiveness and the value for money when utilizing AI chatbots (Moorthy et al. 2019). It considers the perceived usefulness relative to the financial investment or effort required, helping individuals evaluate the benefits and drawbacks of using AI chatbots (Palau-Saumell et al., 2019).

Habit

Habits are automatic, learned actions (Venkatesh et al., 2012). Habitual use of AI chatbots refers to the automatic and routine engagement with these communication mediums, driven by past behaviours and without conscious decision-making (Jacucci et al., 2014). Habits represent a pattern of regular and ingrained utilization of AI chatbots (Perez-Vega et al., 2021).

The UTAUT2 framework provides a comprehensive understanding of technology acceptance and usage behavior by considering these seven key constructs. It recognizes the influence of individual beliefs, social factors, and contextual conditions in shaping users' acceptance and adoption of technology. Empirical evidence from various studies supports the validity and effectiveness of the UTAUT2 framework. Researchers have applied UTAUT2 in diverse settings, including e-learning, mobile learning, and AI-based systems, and have consistently found significant relationships between the constructs and technology acceptance. Studies provide empirical support for the UTAUT2 framework, reinforcing its utility in understanding individuals' technology acceptance and usage behavior in different educational contexts.

Methodology

This study employed a qualitative methodology to examine the influence of an AI chatbot on student engagement and support within higher education. Specifically, an Interpretive Phenomenological Analysis (IPA) was employed to analyze collected data and derive findings in response to the research questions**.** IPA, which has gained prominence across diverse academic fields, is recognized for its value in investigating existential experiences (Finlay, 2011). Offering a versatile and adaptable approach, IPA serves as a promising method for comprehending individuals' lived experiences (Smith et al., 2009). IPA has the potential to understand and interpret people's experiences, facilitated by its practical and accessible guidelines (Shinebourne & Smith, 2009a, 2010; Smith & Osborn, 2003). It is essential, however, to acknowledge IPA's methodological limitations and carefully consider them in its application.

Participant Selection, Sample Size and Techniques

The present study examined the influence of an AI chatbot on student engagement and support within higher education. The study had a specific focus on the perceptions of students from Kerala, India. This decision was made to gather comprehensive data from this population and gain a nuanced understanding of the phenomenon under investigation. The target population consisted of students who were interviewed or approached to respond to open-ended self-administered questions. A purposive sampling technique was used to collect data, resulting in a sample of 11 participants. The sample included seven (64%) males and four (36%) females. Additionally, the sample encompassed a diverse range of educational backgrounds, including five (45%) students who were pursuing postgraduate studies and six (55%) individuals who were engaged in university and doctoral research in education, management, and science. The

selected participants possessed relevant knowledge pertaining to the phenomenon under investigation, making them well-suited for the study.

Prior to conducting the interviews, the research team obtained informed consent and assessed the participants' willingness to participate in the study. Permission was also sought from the university dean to conduct the research. The researcher adhered to the Committee on Publication Ethics guidelines throughout the research process. Participants were assured of the confidentiality of their personal information, and steps were taken to ensure the privacy and security of their data.

Interview Process

In conducting the interviews for this study, it was important to maintain a focus on listening to the participants and understanding the meanings associated with their experiences, rather than simply seeking direct answers to predetermined questions (Roberts, 2020). The interviews were conducted face-to-face between mid-March and the first week of April 2023. Each interview lasted approximately 40 to 50 minutes. Eight semi-structured questions were prepared beforehand, covering topics related to general chatbot usage, chatbot usage at their institution or university, and expectations of AI chatbot functionality. Additionally, personal questions such as the participant's course of study, type of institution, and years of experience using AI chatbot were included. Some spontaneous questions were also asked during the interviews to clarify responses.

To maintain structure during the interviews, the list of questions was used as a reference, but the researcher allowed for flexibility and deviation from the list to explore important topics further (Roberts, 2020). While specific probes were not written down, the researcher employed them during the interviews to keep the participants engaged, summarize the topics, manage the flow of the conversation, and ensure understanding. Probes such as "Please continue," "That's intriguing, could you provide further details?" or "Could you revisit and explain more about?" were used. The purpose of the probes was to maintain engagement, summarize key points, ensure a smooth conversation flow, and check for comprehension, all in accordance with Roberts' (2020) suggestions. By following these interview techniques, the researcher aimed to elicit rich and detailed responses from participants, allowing them to share their expertise and knowledge of their experiences using AI chatbots. This approach aligned with Roberts' (2020) recommendations regarding the importance of listening to participants and viewing them as experts in answering research questions.

Data Analysis

The study employed the Systematic Text Condensation (STC) method, a widely utilized approach within the framework of IPA, to analyse interview data. The application of the STC method involved a structured five-step process: identifying and extracting distinct segments of text as Meaning Units, distilling and paraphrasing these into Condensed Meaning Units, assigning codes for organization, aggregating related codes into Sub Themes that highlight

patterns, and ultimately synthesizing these into overarching Themes (Malterud, 2012). A comprehensive explanation of this method, complete with illustrative details, is available in the Appendices section of the paper.

Results

The exploration of students' perspectives of AI chatbots uncovered eight distinct themes. These themes included Dual (Effectiveness and Limitations), Beyond, Enrichment, Optimization, Synergize, Streamlining Communication, Engage+AI, and Refine. Each theme provided insight into AI chatbots' multifaceted functions within the realm of higher education and beyond. These themes provide valuable insight into the dynamic interplay between AI chatbots and the educational landscape.

The theme of "Dual Effectiveness and Limitations" explores the contrasting aspects of AI chatbots, specifically their ability to provide quick assistance and their limitations in addressing complex issues. For example, Respondent 3 stated, "Personally, I find chatbots quite helpful. They offer convenience by eliminating the need to wait for customer service representatives. Chatbots provide instant assistance and guide me through various processes, like my PhD admission process, making interactions efficient and hassle-free." Respondent perspectives connected to the theme by exemplifying the contrasting aspects of chatbots' effectiveness in providing quick assistance and their limitations in addressing more intricate matters, such as those encountered during a PhD admissions process. This duality highlighted the necessity of adopting a well-balanced approach that maximizes the advantages of both elements while recognizing and addressing their respective drawbacks, thereby fostering a strategic and effective utilization strategy (Green & Johnson, 2021; Okonkwo & Ade-Ibijola, 2021).

Transitioning to the theme of "Beyond," a deeper examination revealed the extended influence of AI chatbots beyond the traditional boundaries of education. The subthemes of "Smooth User Experience" and "Communication Challenges" provided perspective on the effortless interactions encountered by students, contrasted with potential obstacles in communication (Kooli, 2023; Pereira et al., 2019). For instance, Respondent eight explained, "Absolutely, AI chatbots have gone beyond just assisting with education. They contribute to a much broader impact. For instance, the Smooth User Experience they provide is remarkable. I find it easy to interact with them, accessing information and resources seamlessly. This makes my academic journey smoother." This participant recognized AI chatbots' influence beyond education. This enhancement in the academic journey signified the "Beyond" theme, where chatbots go beyond norms to elevate user experiences. Another illustration comes from Respondent 11 who explained, "Of course, while the experience is generally smooth, there are times when the Communication Challenges emerge. AI Chatbots might struggle to understand complex medical queries or interpret specific nuances. This can lead to misunderstandings or incomplete responses. So, while they excel in many ways, there's room for improvement in certain areas." The respondent pointed out that despite the overall smoothness of their interaction with AI chatbots, they've encountered instances of "Communication Challenges." These challenges arose when chatbots face difficulty comprehending intricate medical queries or grasping

specific nuances. Consequently, this can result in misunderstandings or responses that lack completeness.

While AI chatbots have strengths, the participants highlighted their limitations, indicating potential for enhancement in specific aspects. The theme explored the transformative potential of AI chatbots to surpass traditional roles and expand the scope of engagement. The focus of this discussion centered on the concept of "Enrichment," with particular attention given to comprehensive improvements AI chatbots offer to individuals' daily experiences. This led to the subtheme of "Personalized Recommendations." This subtheme was acknowledged by one respondent who stated, "Let's say I'm looking for research materials. The chatbots not only help me find relevant resources but also suggest related readings based on my past searches. It's like having a study partner who knows my needs." Another subtheme of "Real-Time Updates and Navigation" enhanced the personalized and timely assistance offered, enhancing both recreational activities and regular tasks (Cunningham-Nelson et al., 2019). This theme encompasses the ability of AI chatbots to enhance user experiences by providing personalized and dynamic assistance.

Advancing to the theme of "Optimization," attention is drawn to the refined communication processes facilitated by AI chatbots. The subthemes of "Enhanced Communication Experience" and "Streamlined Efficiency" are indicative of heightened engagement and prompt response times, as evidenced by Kuhail et al. (2022) and Lee et al. (2020). This theme reflected AI chatbots' potential to optimize communication, ultimately heightening user satisfaction and experiences.

The theme of "Synergize" emphasized the harmonious integration of AI chatbots with human elements. Addressing concerns about "Data Security and Confidentiality" and "Reliability and Accuracy," this theme advocated for a collaborative utilization approach (Touimi et al., 2020; Wang et al., 2021). "Human Interaction" and "Personalization" contributed to a holistic interaction paradigm, emphasizing mutual reinforcement and effectiveness. Respondent 7 for instance, noted, "Well, it's a delicate balance. AI chatbots can streamline tasks and provide quick assistance, but when it comes to personal or confidential matters, human expertise is crucial. We need to ensure that sensitive data is handled securely and that there's a human touch for situations that require empathy and understanding."

The theme of "Streamlining Communication" explored the symbiotic relationship between AI chatbots and human engagement. While "Efficient and Accurate Responses" enhanced interactions, "Limitations in Complex Inquiries" underscored areas where human judgment remains vital. "Complementary Role with Human Support" suggested that AI chatbots can enhance human resources for specialized tasks, emphasizing seamless coexistence (Khan et al., 2019). The central focus of the "Engage + AI" theme accentuated collaborative interactions between students and AI chatbots, illustrated by a Respondent 5 who said, "From my experience, I've noticed how students and AI, like ChatGPT, team up. For example, when I needed insights for financial analysis, ChatGPT quickly gave me relevant information, making my work more effective."

Subthemes like “Convenience and Efficiency” and “Personalization and Recommendations” exemplified AI chatbots’ ability to stimulate student engagement (Kuhail et al., 2022; Tlili et al., 2023). Additional subthemes, such as “Trust and Social Influence” and the role of being a “Reliable and Knowledgeable Resource” were exemplified by Respondent 7 who explained, This whole interaction between scholars and AI is interesting. For instance, when I needed advice for survey design, ChatGPT’s reliable insights boosted my engagement and helped improve my research quality.” These elements depicted AI chatbots as catalysts for creating immersive user experiences.

Finally, the theme of “Refine” encompassed the iterative process of enhancing AI chatbots. Subthemes such as “Natural Language Understanding and Adaptability” and “User Experience and Interface Design” underlined ongoing improvements. “Speed and Accuracy” highlighted the importance of promptness. This theme signified the continuous refinement of AI chatbots’ capabilities, ensuring sustained user satisfaction and usability (Tlili et al., 2023).

To summarize, the presence and potential of AI chatbots in higher education are made clear by eight themes, together they portray AI chatbots as dynamic agents of transformation and innovation. Through theoretical consistency and conceptual alignment, the UTAUT2 model’s constructs with identified themes and subthemes provided a comprehensive framework for understanding AI chatbots’ multifaceted contributions and how they might shape the future for students in higher education.

Study Themes Collated with the UTAUT2 Constructs

The connection between the identified themes and the UTAUT2 (Venkatesh et al., 2003; Venkatesh et al. 2012) constructs was established by a meticulous assessment applying two rigorous criteria: theoretical consistency and conceptual alignment. The theoretical consistency of the UTAUT2 model was demonstrated through its integration of established theories from diverse It aligns with principles of technology acceptance and adoption, ensuring logical soundness and relevance (Lee & Rho, 2013; Venkatesh et al., 2003 & 2012). The UTAUT2 model achieves robust conceptual alignment by seamlessly integrating and extending core components from established technology adoption theories such as Technology Acceptance Model (Davis, 1989), the Theory of Planned Behavior (Ajzen, 1991), and the Innovation Diffusion Theory (Rogers, 1961). Through this synthesis of constructs, UTAUT2 offered a comprehensive framework for understanding the multifaceted factors shaping technology acceptance, while also accommodating contextual intricacies. This alignment enhanced its practical relevance and theoretical robustness, contributing to its prominence in contemporary research (Lee & Rho, 2013; Venkatesh et al., 2003; Venkatesh et al., 2012).

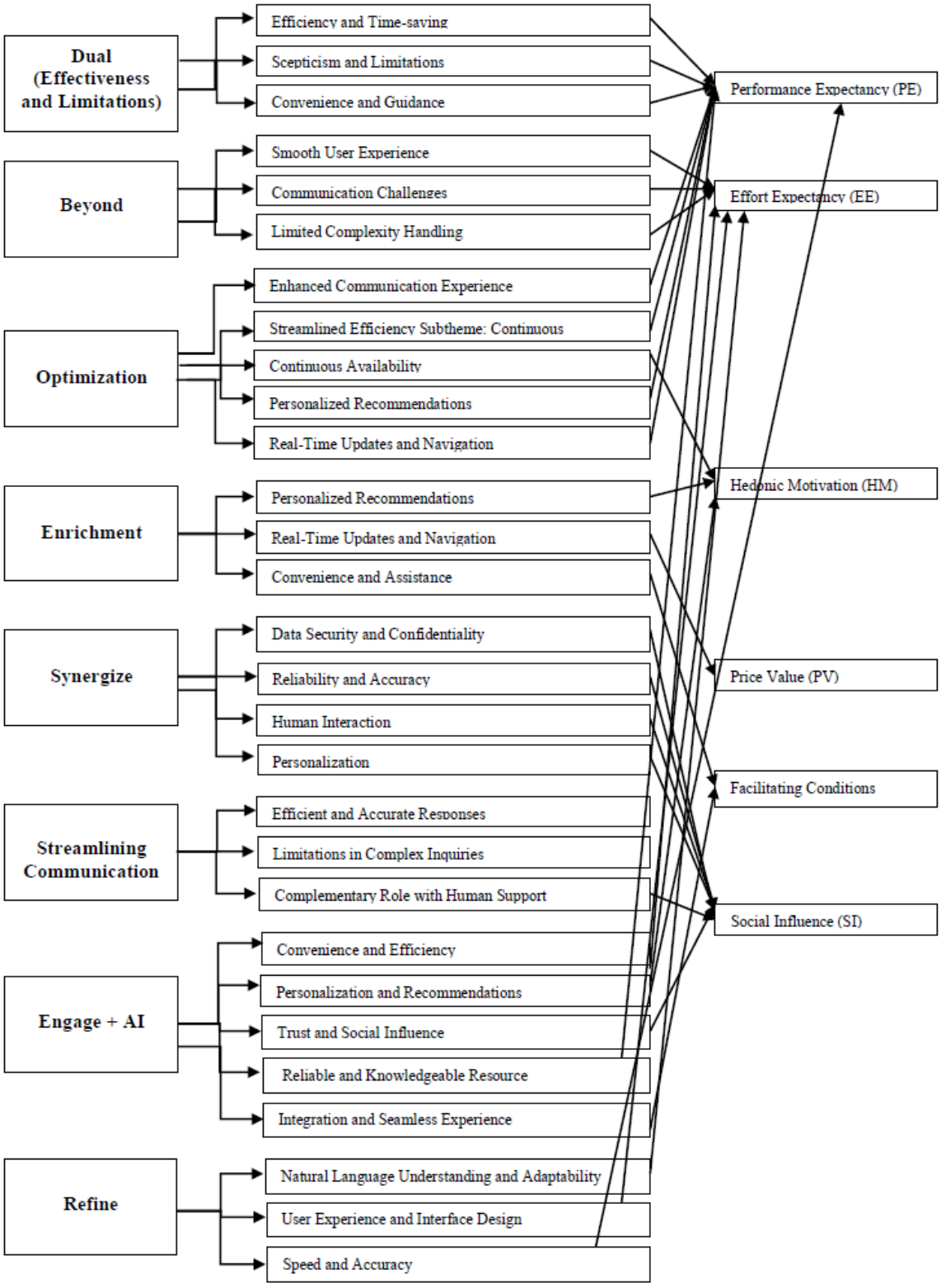
Integration of the UTAUT2 Constructs with Identified Themes

The analysis of AI chatbots themes and subthemes in the context of UTAUT2 (Venkatesh et al., 2003; Venkatesh et al. 2012) constructs revealed a strong theoretical consistency and conceptual alignment. The “Dual (Effectiveness and Limitations)” theme, including subthemes

"Efficiency and Time-saving", "Skepticism and Limitations" and "Convenience and Guidance" aligned with Performance Expectancy (PE), capturing users' expectations of benefits and concerns. The "Beyond" theme, with subthemes "Smooth User Experience" and "Communication Challenges," corresponded to Effort Expectancy (EE), highlighting convenience and potential difficulties. "Enrichment" subthemes like "Personalized Recommendations" related to Hedonic Motivation (HM), focusing on enjoyment and enhancement. "Optimization" subthemes such as "Enhanced Communication Experience," aligned with Performance Expectancy (PE) by emphasizing improved task execution. The "Synergize" theme, featuring subthemes like "Data Security and Confidentiality," aligned with Social Influence (SI), reflecting the influence of norms. The "Streamlining Communication" subtheme tied to Performance Expectancy (PE) and Social Influence (SI), while the "Engage+AI" subthemes, including "Trust and Social Influence," aligned with Performance Expectancy (PE) and Social Influence (SI). Finally, the "Refine" theme, with subthemes "Natural Language Understanding and Adaptability," aligned with Effort Expectancy (EE). This analysis demonstrated the UTAUT2 model's robustness in capturing AI chatbots' adoption complexities.

Figure 1

Integration of the UTAUT2 Constructs with Identified Themes



Discussion

The discussion section comprehensively addresses the main research questions, which are divided into two distinct segments. The first segment examines into the perceptions surrounding the augmentation of student engagement and support in higher education through the utilization of AI chatbots. The second segment critically examines the multifaceted factors that intricately mold student preferences concerning the deployment of AI chatbots for communication within higher education. In particular, the second segment focuses on the intricate interplay between security, privacy considerations, and the decision-making processes that support the adoption of AI chatbots for addressing a spectrum of academic inquiries, encompassing admissions, course-related matters, academic affairs, and library resources.

Perceptions of AI Chatbots in Enhancing Student Engagement and Support in Higher Education

AI chatbots play a diverse role in higher education, revealing different aspects that enhance student engagement and academic support (Pérez et al., 2020; Abbas et al., 2022; Studente et al., 2020). They have both strengths and limitations, efficiently providing quick answers to common queries, but struggling with more complex issues. These chatbots are handy for routine tasks, like giving timely information and helping with administrative matters, but doubts remain about their ability to handle intricate problems. Striking a balance between their strengths and weaknesses is crucial (Green & Johnson, 2021). However, chatbots also go beyond education, improving user experiences by offering smooth interactions and addressing communication challenges (Kooli, 2023; Tlili et al., 2023). While they might not excel at handling complex interactions, they enrich experiences in various ways, such as easing university transitions and promoting peer connections (Kooli, 2023; Tlili et al., 2023; Studente et al., 2020). Moreover, they provide personalized recommendations and real-time updates that enhance daily routines, making them convenient and supportive (Kuhail et al., 2022). These chatbots don't just assist in education but also streamline administrative tasks, allowing teachers and staff to focus on more intricate matters (Lee et al., 2020; Okonkwo & Ade-Ibijola, 2021).

AI chatbots optimize communication, enhancing the overall experience. They improve engagement, offer spot responses, and suggest personalized recommendations, leading to higher satisfaction (Lee et al., 2020). Availability around the clock is also important for consistent support (Green & Johnson, 2021). Chatbots work in synergy with human interaction, balancing concerns about data security and confidentiality. They contribute to a comprehensive approach and show potential for beneficial collaboration between humans and technology (Watson et al., 2022; Khan et al., 2019). AI chatbots and human engagement complement each other, making interactions efficient and accurate. While they shine in straightforward responses, human judgment is irreplaceable for complex inquiries (Green & Johnson, 2021). They have the potential to enhance specialized tasks, acting as valuable partners alongside humans (Touimi et al., 2020). They also engage users effectively by offering convenient interactions and personalized suggestions (Kuhail et al., 2022; Studente et al., 2020). There's an ongoing effort to refine AI chatbots. Improving their natural language understanding, adaptability, user experience, interface design, speed, and accuracy are important for ensuring user satisfaction over time (Li et al. 2021). Based on the current research findings, students view AI chatbots as valuable tools in higher education, offering rapid assistance, boosting engagement, and simplifying communication, all while aiming for ongoing enhancement.

Factors Shaping Student Preferences for AI Chatbots in Higher Education: Addressing Security, Privacy, and Decision-Making

The influence of AI chatbots as a means of communication in higher education is examined through the UTAUT2 framework (Venkatesh et al., 2012). This framework provided valuable insight into the factors that shape students' preferences for using AI chatbots and how these preferences can impact engagement and support. One key factor that affected participants' views on AI chatbots communication was "Performance Expectancy," an aspect of UTAUT2. This factor related to the belief that AI chatbots can enhance educational outcomes and improve the overall student experience (Liu et al., 2019). This aligned with the idea highlighted in the "Dual (Effectiveness and Limitations)" theme, which emphasized the efficiency of AI chatbots in delivering timely and consistent information (Pérez et al., 2020; Abbas et al., 2022). Such a positive perception can significantly influence students' inclination towards AI chatbots and impact their preferences. This factor referred to how user-friendly and easy it was to interact with AI chatbots (Johannsen et al., 2018). This aligned with the "Engage+AI" theme, which illustrated how chatbots enhance user engagement through convenience, efficiency, and personalized recommendations (Kuhail et al., 2022). When students perceive AI chatbots as effortless to use, they are more likely to adopt them for communication.

The influence of peers, instructors, and institutional norms, known as "Social Influence," corresponded with the "Synergize" theme. Positive feedback and recommendations from peers and instructors significantly shaped participants' willingness to use AI chatbots (Watson et al., 2022; Khan et al., 2019). This is consistent with UTAUT2's emphasis on social factors impacting technology adoption (Wang et al., 2021). Additionally, the "Facilitating Conditions" aspect of UTAUT2 is vital. This factor highlighted the necessity for a supportive environment, including reliable internet access and technical assistance (Li et al., 2021). This aligned with the "Optimization" theme, where AI chatbots were refined to provide enhanced communication experiences (Lee et al., 2020). Furthermore, concerns related to security, privacy, and other factors influenced participants' decisions regarding AI chatbot adoption. These concerns were addressed within the "Synergize" theme, which emphasized the importance of finding a balance between data security, confidentiality, and reliability (Kooli, 2023). Addressing these concerns is crucial for building student trust in AI chatbot communication. The combined insights from this study's themes and the UTAUT2 constructs elucidate how students perceive the role of AI chatbots in improving engagement and support in higher education. These discussions offer a comprehensive understanding of the factors that influence students' preferences for AI chatbot communication and how these preferences can impact their educational experiences.

Limitations and Future Research Directions

The present study's scope and generalizability are rooted in a specific higher education context, potentially limiting the transferability of the findings to more diverse environments or student populations. In addition, the small sample size ($n = 11$) might not fully encompass the spectrum of student perceptions, potentially restricting a comprehensive understanding. While the phenomenological approach provides rich insights, subjectivity in data interpretation, influenced by the researcher's perspective, could introduce bias. The cross-sectional design might miss temporal shifts, suggesting the value of longitudinal studies for dynamic insights. Differing AI familiarity levels among participants could have led to varied interpretations. Despite efforts for objectivity, researcher biases could impact design, data collection, and analysis. Unaccounted external influences like media portrayal might have affected

participants' perceptions. Prioritizing depth over breadth, the study might limit a holistic understanding of AI chatbots perceptions. Sole reliance on phenomenological analysis could be enriched by multiple methodologies. Ethical concerns arise around personal perceptions and privacy. These limitations call for cautious interpretation, while future research paths offer exciting potential for enhancing AI chatbot communication in education. Longitudinal studies might track AI chatbots' impact over time, while comparative studies offer context-specific insights. A blend of qualitative and quantitative research can uncover user experiences, and ethical considerations ensure responsible practices. Professional development for staff can optimize integration, enriching AI chatbot communication and elevating the educational landscape through enhanced engagement and support.

Conclusion

This study has significantly advanced the field's comprehension of AI chatbot communication within higher education, spotlighting its substantial role in bolstering student engagement and support. Employing a meticulous analysis of thematic patterns and subthemes through the lens of UTAUT2 constructs, it has propelled the field forward by furnishing a comprehensive outlook on the adoption and embrace of AI chatbots. The main findings (results) of the study fit well with previous literature that also talk about numerous benefits of AI chatbots used in higher education. These benefits include giving personalized help, making administrative tasks smoother, and increasing interactions between students and others (Okonkwo & Ade-Ibijola, 2020; Cunningham-Nelson et al., 2019; Green & Johnson, 2021).

It is also important to know about the limits in how this study was done, which makes sure the research is truthful and strong. The way the study used phenomenological questions and IPA gave the researchers a good sense of the participants' real experiences, but it is also important to know that these ideas can't show why things happen or how students think in every situation (Tuffour, 2017; Smith et al., 2009). This study adds to what we know by not only showing what AI chatbots can do, but also their limitations and challenges. It talks about how important it is to think about the things that make them work well, like what helps them, how students think, and making them better over time. At the same time, it knows that there are some things it couldn't look at, like only studying specific parts and using what students already know. The next step is to look at new things, like studying more ideas, using new discoveries, and looking at different level of education. Even though this study only looks at colleges and university, its ideas can help other levels of education, too. In a world where AI chatbots are changing how we talk and learn in higher education, this research is like a strong start, giving us ideas for more research and ways to make them even better (Kooli, 2023; Dwivedi et al., 2023; Mendoza et al., 2020; Watson et al., 2022). Knowing about its limits, facing its challenges, and giving helpful advice, this study builds a strong base for us to learn more about AI chatbots in higher education.

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Appendixes

Table 1

STC Table, Model of Data Analysis Arriving Codes and Theme

Meaning Unit	Condensed Meaning Unit	Code	Sub theme	Theme
1. What is your opinion on AI chatbots and do you find them helpful? Please provide a detailed description of your viewpoint. Respondent (R) 1: I believe chatbots are incredibly helpful. They provide quick and accurate responses, saving time and effort in finding information or resolving queries. Their availability 24/7 ensures immediate support, making them a valuable tool in today's fast-paced world. R 2: Personally, I find chatbots quite helpful. They offer convenience by eliminating the need to wait for customer service representatives. Chatbots provide instant assistance and guide me through various processes, making my interactions efficient and hassle-free.	Chatbots are helpful in providing quick and accurate responses, saving time and effort. Chatbots offer convenience by providing instant assistance and guiding users	Chatbots are helpful in providing quick and accurate responses, saving time and effort for users.	Efficient and Time-saving	

R 3: I'm skeptical about chatbots' effectiveness. While they can handle basic queries, complex issues often require human intervention. Chatbots sometimes fail to understand nuanced questions, leading to frustration and a need for human support. R 4: Chatbots are a mixed bag for me. In some cases, they provide useful information promptly. However, when faced with more specific or personalized queries, chatbots often fall short and fail to deliver the level of assistance I require. R 5: I find chatbots helpful in certain contexts. For simple tasks like checking order statuses or getting basic information, they excel. However, when it comes to more complex discussions or problem-solving, human interaction remains irreplaceable. R 6: Chatbots are a great concept, but their execution needs improvement. While they offer quick responses, the lack of	through various processes. Skepticism exists regarding Chatbots' effectiveness, especially for handling complex issues that may require human intervention. Chatbots are useful for simple tasks but may fall short when	Skepticism surrounding chatbots' effectiveness, particularly in handling complex issues that may require human intervention	Skepticism and Limitations	Dual (Effectiveness and Limitations)

human touch can be frustrating at times. I appreciate their availability, but there's still room for enhancing their capabilities. R7: Personally, I haven't found chatbots to be particularly helpful. Their pre-programmed responses often fail to address my specific needs. I prefer direct human interaction for a more personalized and tailored experience. R 8: I see the potential of chatbots and their usefulness. As technology advances, they continue to improve, providing more accurate and comprehensive assistance. While they may not be perfect, their convenience and accessibility outweigh any drawbacks. R 9: Chatbots are a valuable tool in certain situations. Their ability to provide quick answers and support can be beneficial, especially for routine inquiries. However, when it comes to	faced with specific or personalized queries. It has potential and continues to improve, but there is a need to enhance their capabilities and address the lack of human touch.	Offer convenience by providing instant assistance and guiding users through various processes.	Convenience and Guidance	

complex or sensitive matters, human interaction remains essential. R 10: I find chatbots helpful, especially in scenarios where human assistance is limited or unavailable. They provide instant responses, reduce waiting time, and offer guidance in a self-service manner. However, for more complex issues, I prefer interacting with a human representative. R11: My opinion on chatbots is neutral. While they can be helpful in providing basic information, I believe that human interaction brings a personal touch and better understanding.				

Table2

Items wise Codes and Theme

Items	Code	Sub theme	Theme
2. How has been your experience when using a chatbots outside of the education field? How would you describe your recollection of it and the overall user experience?	"The positive aspect of the chatbots outside of education, emphasizing its easy navigation, quick responses, and overall seamless user experience".	Smooth User Experience	
	"Frustration experienced when the chatbots failed to understand queries and provided	Communication Challenges	Beyond

	irrelevant responses, leading to wasted time and a frustrating user experience". "Its ability to quickly resolve queries and provide personalized responses, resulting in a satisfactory user experience",	Limited Complexity Handling	
3. Do you believe chatbots are capable of delivering useful services or information? If so, what specific types of services would you find acceptable for a chatbots to provide, other than basic course and University information?	"Chatbots providing tailored suggestions for books, movies, and other interests". "Chatbots delivering real-time traffic updates and alternative route suggestions". "Scheduling appointments, sending reminders, and providing financial advice or budgeting assistance".	Personalized Recommendations Real-Time Updates and Navigation "Convenience and Assistance".	Enrichment
4. What were the primary factors that influenced your decision to choose AI chatbots as a means of communication with an institution/university?	"AI chatbots offer easy access to information and provide convenient communication with the university". "Streamline communication processes, resulting in faster responses and reduced waiting times". "Ensuring assistance is accessible at any time, including outside regular office hours".	Enhanced Communication Experience Streamlined Efficiency Continuous Availability	Optimization
5. Do you have any specific reasons or	"Concerns about the safety and protection	Data Security and Confidentiality	

concerns that would deter you from choosing AI chatbots as a communication channel with your institution/ university particularly in terms of security, privacy, or any other factors?	of personal information, including worries about data breaches and unauthorized access". "Desire for private conversations and a preference for human representatives over automated systems to ensure confidentiality and privacy". "Incorrect information or misinterpret queries, leading to misunderstandings or incorrect decisions". "The value of human touch and personalized interaction, which may be lacking in AI chatbots communication". "The ability of AI chatbots to understand individual needs and provide tailored solutions, resulting in a lack of customization and personalization".	Reliability and Accuracy Human Interaction Personalization	Synergize
6. Do you believe AI chatbots have the capability to serve as a communication medium for addressing your inquiries with the institution/ university regarding admissions, course and academic related, and library reference?	"Quick and accurate responses, saving time for both users and institutions". "To handle complex inquiries that requires human judgment and empathy".	Efficient and Accurate Responses Limitations in Complex Inquiries	Streamlining Communication

	"Handling basic inquiries and freeing up human resources for more specialized or complex tasks".	Complementary Role with Human Support	
7. What factors would motivate you to repeatedly use an AI chatbots at the institution/university instead of email, creating a regular usage pattern? Would a recommendation from a friend, or peer influence your decision to use it?	"AI chatbots as a motivating factor for repeated usage. Users appreciate the quick access to information, prompt responses, and streamlined communication process". "Users are motivated to use chatbots repeatedly when they can understand their preferences and provide relevant suggestions". "Users are more likely to adopt regular usage patterns if they receive positive feedback or endorsements from trusted sources". "When they can rely on them as a reliable and knowledgeable resource". "The integration of AI chatbots with other university systems and platforms and they can seamlessly connect with various tools and enhance their overall experience.	Convenience and Efficiency Personalization and Recommendations Trust and Social Influence Enlighten Integration and Seamless Experience	Engage+AI
8. What feature do you consider the most	"Chatbots ability to understand and		

important in an AI chatbots? Please explain your expectations and walk me through the key aspects you prioritize.	interpret queries in natural language". "The significance of tailoring the chatbots responses and interactions to the user's preferences". "The user's expectations for prompt and accurate responses from the chatbots, emphasizing the need for efficient and reliable interactions".	Natural Language Understanding and Adaptability User Experience and Interface Design Speed and Accuracy	Refine

Post-COVID-19 Higher Learning: Towards Telagogy, A Web-Based Learning Experience

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Abstract

Institutes of higher education (IHEs) have to consider benefits of remote learning post-pandemic. Retrogression to physical contact is counterproductive. The hasty implementation of remote learning during the pandemic deprived IHEs of opportunities to efficiently enact and theorise about it. Post-pandemic, IHEs have opportunities to theorise about remote learning hence the questions; a) what type of learning emerges when asynchronous and technology-as-essence framework undergirds students learning? b) What benefits accrue when chat-Generative Pre-training Transformer (chat-GPT) is infused into students learning? Use of synchronous learning and technology-as-utility framework to underpin remote learning during the pandemic was intended to retain most of physical contact learning traditions. Teachers and students met synchronously and simultaneously online for learning to occur. IHEs safeguarded their operational efficiency to minimise the disruptive nature of remote learning. The purpose of the study was to theoretically examine effects of asynchronous learning and "technology-as-essence framework on students learning. Asynchronous learning occurs when students registered on the same course learn online on their own schedule without any real-time interactions with teachers. This phenomenon occurs when remote learning develops through technological advances that, beyond 2030, would most likely stream educational courses similar to Netflix. One such technological advance is chat-GPT. A study was undertaken to better understand it. 15 multi-disciplinary advanced undergraduates tested out chat-GPT on their assignments and a concrete problem. Chat-GPT lessened the time of doing assignments and improves students' problem solving abilities. AI systems advances have a positive effect on students learning. The study addresses the positive impact of asynchronous learning and advances in technology on IHEs.

Keywords: artificial intelligence, chat-GPT, remote learning, technology, Post-COVID-19 pandemic

The post-pandemic era provides Institutes of Higher Education (IHEs) with opportunities to reimagine learning within the ambit of advanced remote learning. Remote learning refers to a mode of learning that occurs online via scheduled Zoom classes and Bright-space activities because in-person traditional classroom learning was not possible during the Covid-19 pandemic (Burke and Locmele, 2022; Neuwirth, 2021; Torres and Ortega-dela Cruz, 2022). It thrives on synchronous learning where students and teachers meet in live online classes in order for learning and teaching to take place. While occurring online, synchronous remote learning tends to mimic in-person contact sessions. I argue that remote learning that assumes an asynchronous learning approach is likely to help IHEs to reimagine learning in the digital age. An asynchronous approach refers to any mode of online learning undertaken at the behest of students' own schedule and has no need for live online interactions between students and teachers. It shares similarities with heutagogy (Blasche, 2012) where students access learning content as and when they are ready to do so, at their own pace, anywhere and anytime. The brick-and-mortar traditional classrooms are becoming increasingly outdated and would struggle to survive outside online learning. The asynchronous student-centred learning approach with a strong self-determination character that builds students' capabilities to be autonomous, self-reliant, and technologically savvy represents a way forward for IHEs. I refer to this type of online, web-based learning as telagogy. I also forecast that beyond 2030, telagogy would become an asynchronous, online learning experience that would be streamed like Netflix and controlled fully by students as Wright (2020) suggests. Telagogy would also enable students to curate their own personal curriculum drawing educational courses from universities across the entire world. This would compel IHEs to develop universal accreditation systems. It is these meanings of telagogy that make it an advanced form of remote learning. It is anticipated that governments may consider funding students instead of universities.

Another crucial feature of telagogy would be to fundamentally shift the work of human teachers away from textbooks and study guides towards new role demands. Sterling (2020) suggests that university teachers ought to stop trying to write down knowledge that is already available in many AI systems such as chat-GPT and refocus their energies on how to better incorporate these AI and advanced technology capabilities in student learning. Asynchronous approach to learning, in particular, reconfigures human teachers' role in advanced remote learning and is critical in theorising about learning and teaching in the digital age. Options of asynchronous learning for human teachers include posting, developing text or multimedia resources, preparing online polls/quizzes, students' contribution to collectively authored resources and co-creating educational course blogs, creating educational You-Tube videos (Buxton, 2014; Watts, 2016; National Forum, 2020; Butler, 2020). Asynchronous online learning opens spaces to determine future imaginings of remote learning that include online streaming of educational courses, digital accreditation of personal curricula of students, digital assessment, use of new digital learning techniques such as chat-GPT. This would turn higher education into a diverse, interactive, open, engaging activity (Bayne *et al*, 2020) that fosters self-directed learning, peer learning, and student agency (Blasche, 2012; Junco, 2010; Halupa, 2015). Assessment can be reimagined beyond text-based assessments to include audio-clips, videos with evidence of practical projects that solve community problems, animation, and image making (National Forum, 2020). Another key consideration in seeking advanced remote learning features

includes virtual learning environments (VLEs) that have a proven record of use in online learning particularly on content delivery, digital assessment, lecturer-student engagement, and big data analytics (Anderson, 2016). However, VLEs are not without its critics. The platform is seen as constraining pedagogical practices and undermining digital/web literacy practices (Williams, 2023; National forum, 2020). In this study, concerns about remote learning beyond VLEs and synchronous offerings relate to how technology was viewed during the pandemic. Two main approaches that guided the use of technology in IHEs during COVID-19 pandemic were synchronous learning and technology-as-utility anthropological conception. As already stated, these two approaches restricted remote learning to operational efficiency rather than creating conditions for new theorisations about learning and teaching. The implementation of remote learning during the pandemic relied on synchronous, technology-as-utility framework. The post-pandemic technological framework that is likely to help IHEs to reimagine student learning would thus entail asynchronous, technology-as-essence framework (Heidegger, 1954; 1977 Translation) and is the focus of this study.

The purpose of the study is to better understand students' learning post-pandemic under technological conditions of asynchronicity and technology-as-essence framework (Heidegger, 1954; 1977 Translation) that are key constructs in theorising telagogy as an advanced stage of remote learning. Furthermore, the study seeks a qualitative enquiry of process of using one of the latest AI systems called chat-GPT on students' assignments and their attempts to resolve a concrete problem. Two questions that framed the study were thus:

- What type of learning emerges when asynchronous and technology-as-essence framework undergirds students' learning?
- What benefits accrue when chat-GPT is infused into students' learning?

In the next section, the theoretical framework based in literature review is developed in order to ground the systematic investigation undertaken to better understand students' learning post-pandemic. A conceptual framework that shows technological variables necessary to be infused to shape students learning in the digital age follows the description of the theoretical framework. The research that tested out chat-GPT for student learning is also described including its methods, findings, and discussion.

Theoretical Framework

Theories for online learning such as that of Anderson's Online Learning Model (Anderson, 2011) and Picciano's Integrated Online Learning Model (Picciano, 2017) have evolved over time. These models tend to assume a pedagogical framing within a synchronous and technology-as-utility framework. I argue that this theoretical conception of online learning would not lead to advances in remote learning that could culminate in what I call telagogy, or streaming online educational courses. Telagogy is understood as a method and practice of students' web-based learning that draws from remote learning but goes beyond its pandemic conception as synchronous utility. Remote learning was conceptualised and implemented *force* majeure during the pandemic in a hasty way without any meaningful consideration of new theorisations about

student learning. Almutairi *et al*, (2021) developed an emergency remote learning framework that is mostly synchronous and utility-driven as a response to the learning and teaching crisis of the pandemic era. This crisis was created by the pandemic and the results of Almutairi *et al*, (2021) show that multiple pedagogical approaches were used by IHEs human teachers to enable students learning online. The use of traditional methods and practices of teaching such as pedagogy in online learning is increasingly considered as obsolete. Studies on remote learning beyond the pandemic such as those of Alenezi *et al*, (2022), Ndlovu *et al*, (2022) and Tzimiris *et al*, (2023) continue to theorise about remote learning within the emergency, crisis framework dominated by synchronous learning conception and utility-mode use of technology in education. In this article, I argue that post-pandemic era provides IHEs with opportunities to link and develop it beyond traditional methods and practices of teaching such as those maintained in post-pandemic research on learning and teaching. Traditional meanings of teaching come for sharp scrutiny in this article as relics of the past that needs jettisoning. The effort is intended to muster new theorisations about learning and teaching within asynchronous and technology-as-essence framework (Heidegger, 1954, 1977 Translation). Each traditional teaching mode consists of a target (Skelton, 1995), that is, the learning participants and how they are treated in each learning and teaching encounter. This affects the degree of autonomy, self-determination, and independence of students in the learning encounters (Blasche, 2012). The pedagogical models that focus on instruction based on hard-coded knowledge, signify the role of a teacher as an expert, thrive on passive students learning and strict class attendance remain entrenched in most undergraduate studies (Soare, 2012). When remote learning was imposed, IHEs sought to retain most of the features of pedagogy, such as, delivering content as close to in-person learning as possible, making sure that students and teachers met online at the same time, students undertake e-assessment as close as possible to in-person assessment techniques. These pedagogical interpretations of remote learning are retrogressive and *infra dignitatem*, below the dignity of students in IHEs. Heidegger (1954, 1977 Translation) suggests that for technology to be allowed to perform to its optimal level it would enable humans to progress to what Harari (2012) calls a state of homo deus, when humans become deities. There are concerns that such optimisation of technology would turn it into a harmful tool. The first concern relates to superintelligence when advanced technologies would possess an intelligence greater than the one possessed by a genius-level human being (Bostrom, 2014). This concern brings to sharp scrutiny unmitigated growth of technology beyond human comprehension and control. The concern, however, is impervious to the role of IHEs in optimising human intelligence and smacks of scholasticism, narrow-minded commitment to tradition. Superintelligent technologies challenge humans to augment their intelligence and abandon their debilitating traditions and religiosity. Telagogy provides an intellectual cleft to explore human intelligence beyond its current limitations. The basic mission of IHEs is to develop human intelligence and it cannot do so within their limiting traditions. IHEs also need to revise their theoretical interpretation of formal learning as industrialisation of teaching (performativity). Conceptualised as performativity, learning becomes enforcement of industrial rules and regulations, as well as replication of industrial processes with a strong *techne'* episteme. Such learning still works within authority-subordinate relationships of pedagogy (Peters, 2006). This performativity learning reduces human intelligence to an industrial tool and compromises the huge potential of human intelligence, a source of concern with

superintelligence. Psychologised notions of learning from Piaget (cognitivist) and Skinner (behaviourist) represent IHEs' traditions that ought to be challenged in this century.

This study combines the theoretical interpretations of learning, collectively referred to as theories of independence, self-determination, and autonomy (Keegan, 2013), and include Freire's (1970) critical theory of learning, Invitational learning theory drawn from rhetorics (Pitso *et al*, 2014), and critical pragmatism (Tjabane, 2021). It contributes the concept of and justifies advanced remote learning. Telagogy seeks to empower students to deal with concrete community problems hence use of Empowerment Evaluation research method. It is about developing social justice pioneers that make an impact in communities. Telagogy shifts learning not only from synchronous and technology-as-utility framework but also from the underlying epistemology of mimesis towards *poiesis*, that is, towards developing students' productive thinking, creativity, and innovation. Wertheimer (2020) argues that productive thinking is about gaining insights on a particular concrete problem and using reasoned logic plus evidence to craft a solution. AI systems such as chat-GPT would be beneficial for productive thinking and would reconfigure learning away from in-person contact sessions and teacher-centred approaches. Telagogy describes new roles for teachers (Table 1, below).

Table 1
Theoretical Interpretations of Teaching: Locating Telagogy

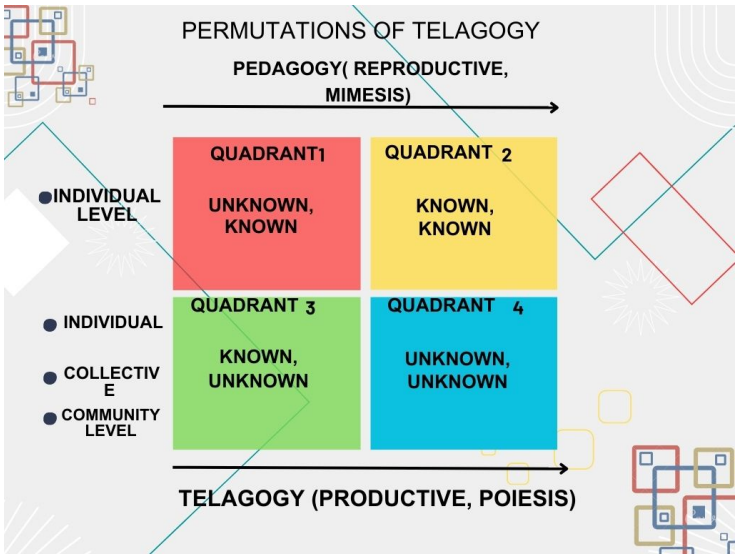
	Traditional	**Performativity**	**Psychologised**	**Critical**	**Invitational**	**Critical Pragmatism**	**Telagogy**
Target	Elite children	Meritocracy	Individuals	Informed Citizenry	Enterprising Individuals	Pragmatic activists	Social justice pioneers
Location	Discipline	Rules & Regulations	Teacher-Learner Relationship	Material Conditions	Material Conditions	Material Conditions	Online Communities & Global Well-being
Epistemic Position	Purist research traditions	Strong pragmatism	Subjective interpretation	Social change	Strong pragmatism	Social idealism	Social idealism
Teacher Role	Subject expert	Standards enforcer	Psycho-diagnostic	Critical intellectualism	Enabler & co-participant	Pragmatic activist	Digital material & online learning techniques developer, automated digital assessment developer, advisory
Purpose	Cultural Reproduction	System efficiency	Effective teaching	Emancipation	Freedom & independence	Just & equitable society	Global citizen + strong ontological reality
Method	Lecture	Work-based Learning	Teamwork	Participatory	Inquiry-driven	Collective problem-solving	Streaming, curation, cloud collaboration, immersive learning

Towards Telagogy: Concepts, Contexts, and Content

The first computer-assisted learning started off in the early 1960s and was called Programmed Logic for Automatic Teaching Operations (PLATO). It represented the initial prototype of learning in a virtual space followed by blended learning, online learning and now remote learning. These computer-based conceptions of learning would undergo, in the next decade, possibly their highest development in the form of online streaming of educational courses along the lines of Spotify or Netflix making new demands on higher learning. Firstly, students are more likely to curate their own curriculum drawing educational courses from universities across the globe and in real time as earlier stated. Secondly, students would study at their own pace, place of preference, anytime as well as anywhere as they undertake e-assessment whenever they are ready. This learning becomes self-directed, self-determined, active, highly flexible, and removes stress in learning. It is positioned at quadrant 3 (Diagram 3, below) that means incorporating all three levels of learning – individual, collective, and local levels. Bowden and Marton (1998) redefined IHEs mission of teaching, research, and community engagement as learning at an individual level (traditionally called teaching), learning at a collective level (research) and learning at a local level (community level). At an individual level, students learn knowledge that is unknown to them but well known by others, experts, and communities of practice. In Diagram 3 below, students move from unknown to known, that is unknown to them as individuals but broadly known knowledge to known, known, that is, students reach a stage of knowing knowledge that is already well known through mostly mimetic, replication learning epistemology. Telagogy does not seek to eliminate individual learning but suggests that this knowledge already exists in AI systems such as chat-GPT. The suggestion is that the first year of study could be dedicated to providing an overview of disciplinary knowledge so that from advanced undergraduate level, students can begin to tackle concrete community problems. Community problems compel for disciplinary knowledge grounding (individual learning), research skills (collective learning) and tackling community problems (local level learning). Once students learn this way then they develop “quality of will”, the scale of commitment to resolving community problems and “knowledge of consequences”, degree of knowing one’s complicity and abdication of responsibility when the community problems remain unresolved. It is argued in this article that community problems are known but ignored and thus remain vague and unattended. In resolving these community problems, students develop productive thinking skills and technological savvy necessary as globe-trotting individuals. It is expected that telagogy, at some point, would pursue blue sky research in quadrant 4.

Figure 1

Permutations of Telagogy



Telagogy is based on communities, both online and physical, thus its underlying essence is a community. This is based on the African concept of *letsema/ilima*. *Letsema/ilima* is a collective assembling of community members driven by the spirit of *ubuNtu* (humanness, social justice) to assist those less privileged in a community to stand up, rise and be able to do things for themselves, that is, build a strong *vukusenzele* work ethic, rise and do it yourself. This explains why telagogy needs an infusion of empowerment theory (Zimmermann, 2000). Empowerment requires the following as described by the former Vice Chancellor of the South African University of Cape Town and the co-founder of Black Consciousness Movement, Mamphela Ramphele (2012):

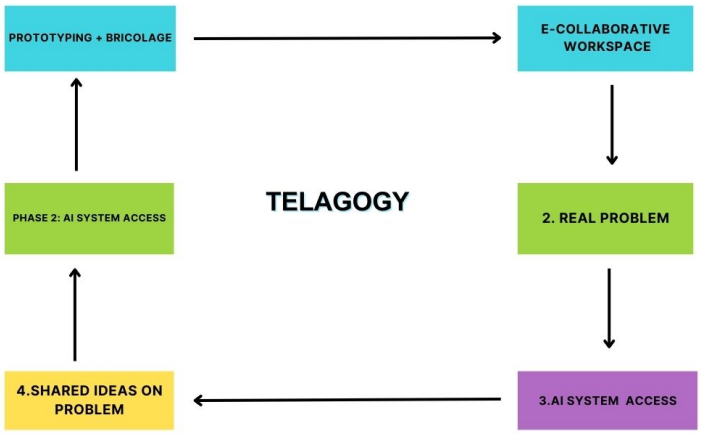
- Substantial shift to global citizentry away from being treated as a subject. This means that one becomes a key agent of change in society who is inspired to tackle societal challenges. In our African context, the journey to citizenry begins with a critical awareness of woundedness from years of colonial ravages not only on land but also on African collective dignity. Approaches to learning, in the African context and Global South, have to take account of the deep-seated inequality and poverty hence the need for the *lestsema/ilima* circle model that leverages firstly, the critical awareness of existing resources, knowledges and insights within a community that unleash citizens fortitude to tackle their own problems. Secondly, generate ideas through ideational bricolage that can be converted to real solutions of pressing community problems. Ideational bricolage is the explicit identification of idle resources within a community that could help find solutions to pressing problems. Thirdly, apply solutions to address identified community problems. Once the circle is completed then it can be iterated.
- Develop a strong sense of autonomy, capabilities to do things on their own to gain *vukusenzele* work ethic. This is similar to Zimmermann's (2000) theory of empowerment. Empowerment theory refers to a situation where communities or

> individuals overcome their psychological oppression, become increasingly aware of community problems and combine their capabilities to resolve these problems driven by a strong *letsema/ilima* motif and the notion of vukusenzele work ethic. This meaning of empowerment goes beyond the traditional psychological conception of empowerment as increased self-esteem, self-efficacy, self-actualisation competences and locus of control (Perkins, 1995, Zimmerman, 2000, Silverton, 2018).

Another area of telagogy worth our attention is the use of chat-GPT in influencing various aspects of students' learning. Studies have focused on student and teacher perceptions of chat-GPT use, possible plagiarism and how it affects students' motivation (Munoz *et al*, 2023). It is also seen as critical in shifting students' learning towards innovation and creative problem solving. Advanced technologies have "ushered in a new era of innovation and creativity in several disciplines, including education" (Munoz, *et al*, 2023: 3). Studies show that when chat-GPT is prompted for answers for assignment completion, it provided accurate responses to the prompted assignment question (Patel, 2023; Halaweh, 2023). Some universities are already developing guidelines for use of chat-GPT in assignments. In this study, the relationships between chat-GPT and student assignments was probed in terms of time of assignment completion and how it assisted students to solve concrete problems. Figure 2 below describes these relationships. In the first instance, students test chat-GPT for the assignments given to them in their respective courses and as they do so, students measure the average time it takes them to complete each item of the assignment and compare it with the average time of doing the assignment manually. In the second instance, students prompt chat-GPT to assist them to frame a concrete problem in ways that helps them develop possible solutions. This includes prompting for innovative solutions.

The starting point of the conceptual framework designed to investigate chat-GPT is an e-collaborative workspace assembled in similar fashion as *letsema/ilima* and applying the *vukusenzele* work ethic. *Letsena/Ilima* e-collaborative workspaces are voluntary and self-determined, empowering community practices (Lebeloane and Baffour, 2008). In these assemblages, students meet to resolve a theoretical or practical problem in a collaborative environment employing the work ethic of *vukuzenzele* meaning arise and do it yourself in lieu of being dependent on another person or conditioned to believe that another person has to be in charge in order for a problem to be solved. In the context of students' learning, it marks a major shift towards students' agentic power in the act of learning. Learning, under these conditions, proceeds on the basis of either a theoretical or real problem. It involves further prompts for chat-GPT on possible innovative solutions. Telagogy would be based mainly on e-collaborative spaces that challenge real problems and less on theoretical problems. It has strong shared ideas and shared solutions approaches to real problem solving. The next section describes in detail a study using chat-GPT.

Figure 2
Diagram of Telagogy



Methodology and Methods

The study is based on Empowerment Evaluation (EE) research method. It is an approach to research that helps participants to not only identify variables or gaps in literature that compromise ongoing project's performance but also provides possible solutions to these problems (Zimmermann, 2000; Fetterman, 1994; Fetterman, 2019). It makes use of qualitative, quantitative, and even mixed methods approaches. The participants were drawn from a pool of advanced undergraduates from Chemical Engineering (N=5), Logistics (N=5), and Accounting (N=5) through use of a purposive sampling. Patton (2002) defines it as selection of data-rich cases for effective use of limited resources. Teachers of second and third-year students were approached in each respective discipline to recommend students that could participate in the study. It was emphasised that, in line with the ethical clearance, students would participate voluntarily in the study and could leave anytime without any repercussions.

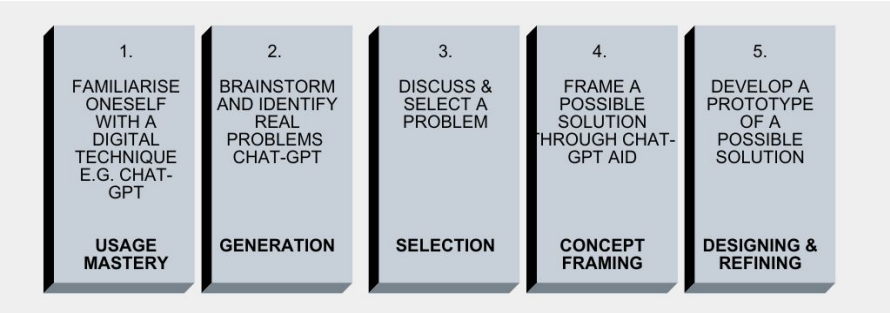
A qualitative EE method called Participatory Evaluation Design was used in this study which consisted of the following phases: training, illumination, facilitation, advocacy, and liberation (Fetterman, 1994). Step 1 of the research design involves responsible planning which entails involving research participants in planning the research. In this phase, students elaborate on their understanding of chat-GPT, its use, and practical applications in their learning. For those who had not been exposed to chat-GPT (about 30% of participants), basic training on use of chat-GPT was conducted. It was downloaded on the laptops, provided to them during the COVID-19 pandemic. Participants trained one another on the use of chat-GPT in their various assignments. This training session was intended to forge collaboration and identify group dynamics in team formation as per the framework developed by Pitso (2020) - pre-connectivity connectivity, early superficial learning, intense interactivity, maturing, deep learning, and resolution. These team formation stages were also intended to serve as an analytical tool for interpretation of collected data. The researcher intended to become a keen observer who interviewed participants in each stage of team formation. Observation included carefully noting participants' interactions, particularly points of agreement, differences, and emerging themes

of cooperation, democratisation of the collaboration space, inclusivity, openness, and degree of flexibility and reflexivity. Interview questions covered issues relating to participants' solicitation of community views on the problem they sought to resolve, their experiences from this research and overall participation in the collaboration. Step 2 and step 3, involved finding out whether participants show a strong sense of owning the process, inclusivity, flexibility, and openness to use and discuss issues relating to chat-GPT. Written semi-structured interviews were conducted. Thereafter, participants were allowed to identify and select concrete problems drawn from their own experiences and had to agree to tackle only one problem for the purpose of this research study. The problem had to emanate from a local community as one of the requirements of the study was for participants to solicit views of select community members. Once such a consensus on a concrete problem was reached, participants prompted chat-GPT to gain better understanding of the problem. Participants also visited a local non-profit organisation to find out its views on the problem at hand. These interviews at the local non-profit organisation were conducted once but ideally, it is suggested that more follow-up interviews are necessary. These stages of research are called illumination and facilitation respectively.

In step 4, students develop a solution prototype and showcase it (advocacy). In the last step, students find a sense of satisfaction for resolving or creating conditions for the resolution of a social problem, "quality of will" and the consequences of their actions are positive (liberation). Written interview schedules were administered to students during the study and post-study. Post-study interviews were intended to check lessons learned and whether participants were ready to embrace learning based on productive thinking, empowerment theory and AI systems.

Issues of validation of research are equally relevant in EE research methods and take the form of qualitative trustworthiness despite Fetterman's (1995) argument that they are less important in empowerment discourses. Truth-value and acknowledging inherent biases in qualitative research designs and sampling techniques are essential in legitimising qualitative research (Noble & Smith, 2015). Truth-value refers to verifiability or falsity of a claim and triangulation or corroboration serves to make a determination of the veracity or mendacity of a claim. Use of two sources of data – observation and interviews – was considered adequate to corroborate for verifiability. Accounting for possible biases was also done carefully, in addition to auditability meaning providing clearer and transparent description of the research process (Noble & Smith, 2015). Finally, there was a need to describe the context of the study and offer thick as well as rich verbatim descriptions of participants' views in support of findings.

Figure 3
EE Participatory Evaluation Design



Results

Data collected in a qualitative study of 15 students that participated in testing the efficacy of chat-GPT in students' assignments and its use in solving a concrete problem were analysed to determine:

- The relationship between students' duration of completing an assignment using chat-GPT as compared to manual completion of an assignment plus potential for plagiarism.
- The relationship between students' use of chat-GPT in attempting to solve a concrete problem and the time of finding solutions was qualitatively tested through interviews with participants. The interviews also included perspectives on whether concrete problem solving helped them become innovativeness.

The variables such as age, socio-economic status of students, level of experience in using AI systems and students' nominal-scale variables such as gender, ethnicity and race were not considered for any meaningful analysis. This was essentially a qualitative, exploratory study. It was intended to demonstrate how AI systems and empowerment theory infused into learning and teaching could enhance better understanding of AI systems and their applications in IHEs within the framework of technology-as-essence. This framing of technology could allow remote learning to develop to its next level of online streaming and thus provide opportunities to theorise about learning and teaching beyond its current limitations.

The interview data shows that 70% of the participants, although it was not a consideration when recruiting, were already using chat-GPT for assignments and were aware of the plagiarism consequences so avoided copying answers from chat-GPT. Most participants indicate that they have had to include in their answers to assignments, information from other sources and curate such knowledge to fit assignment demands. "you gotta realise and become aware of penalties linked to copied text so adjust your answers accordingly" commented one of the participants. In the use of chat-GPT, participants showed a good understanding of plagiarism rules and made effort not to copy answers given to them by chat-GPT. These interviews also show that chat-GPT substantially reduces the time to complete assignments based on existing knowledge and is also capable of suggesting innovative ideas when the

problem is sufficiently specific. When asked whether participants found chat-GPT helpful, one participant commented "chat-GPT saves time and allows one to focus on other things. "
The students found the first stage of the EE method quite useful in familiarising themselves with chat-GPT particularly those who were using it for the first time. While chat-GPT did not substantially reduce the time for completing projects based on a concrete problem, it was useful in clarifying the problem at hand which assisted students' discussions on framing of the problem.

In another study, chat-GPT proved to be better than students at creative problem-solving (Webb *et* al, 2023). In this study emphasis was on productive, creative problem-solving. The meaning of a problem offered by engineering students as a gap between a current situation and a desirable one was quite useful to students' analysis of a concrete problem. A number of factors were identified that caused a current situation to be less than desirable and the ideal situation was described prior to seeking solutions even before prompting chat-GPT. My further observation of participants in attempting to do their project was analysed in terms of Pitso's revised group dynamics process as used for human-machine collaborations (Pitso, 2020). The Smart Team Formation Process (Pitso, 2020) includes:

1. ***Pre-Connectivity***

   This stage involves students familiarising themselves with an AI system under investigation (chat-GPT) and its role in assignments or problem-solving. It also indicates, in early formations of the collaborative team, some anxieties, scepticism, doubt and cynicism from participants concerned with whether a multi-disciplinary team could work together given its diverse knowledge bases and experiences. My observation of this team was that the use of chat-GPT for purposes of familiarisation, stage one of the method, tends to bring the participants closer when they all participate in using chat-GPT to find answers for assignments of one group. For instance, when all of them become involved in seeing how Chat-GPT answers those specific engineering assignments it helps bridge epistemic distances between students and enhances their co-operative spirit in the collaboration spaces. "I never thought I could be involved in an assignment from other courses, this was interesting", a comment from a participant. When introduced to a real, concrete problem, students have already begun to create some understandings of how their discussions should proceed. I observed a greater understanding in using chat-GPT and the increased confidence in the answers prompted from chat-GPT and the realisation that chat-GPT contains terabytes of great content that helps them better understand the problem at hand (Stirling, 2020).

2. ***Connecting/Connectivity***

   An increasing interest in the use of chat-GPT to solve a concrete problem helped to reduce apprehension and doubt in the interactions between participants and chat-GPT. Pitso's (2020) study on group dynamics suggests that teams function better and interact with AI systems confidently when there is a clear and lucid project that students

undertake. It is in this stage that students discussed various community problems that could be their project. Participants settled on potholes that have become a major problem in the South African context compromising logistics and general well-being of communities. When prompting chat-GPT on the meaning of a pothole, the following responses were given by chat-GPT: [A type of a road surface damage that usually appears as a depression or hole. It is usually caused by wear and tear, weather conditions, or the deterioration of road surface. Potholes can vary in size and shape ranging from small, shallow depressions to larger, deeper holes. Potholes form when moisture seeps into the road's surface weakening the underlying layers]. While road maintenance and repair falls under the local government purview, most of them are dysfunctional leading to persistent potholes problems. The most important issue about the project is that none of the participants are trained on the particular problem at hand and have to test the limits of their knowledge and experience. "*I found the explanations of a pothole quite useful and easy to find in chat-GPT*", one of the participants commented. There was also an increasing confidence that the problem at hand could be solved given the role of chat-GPT in providing ready-made answers.

3. Early Superficial Learning

Participants further probed chat-GPT on possible solutions with the following responses: [patching for smaller holes, it involves filling the hole with materials such as asphalt. Potholes filling machine...to fill potholes with hot asphalt. Cold mix asphalt, ready to use mixture. Resurfacing or overlaying, add new layer of asphalt on existing pavement. Proper road maintenance. Advanced road construction techniques such as durable materials, better drainage systems, and proper designs.]. While these suggestions were important, most of them were at a level of municipalities that required huge resources. Participants felt constrained by these chat-GPT responses. This was a crucial moment where participants were exposed to which also showed the limits not only of chat-GPT but also of reproductive knowledge. The greater realisation of the superficiality of such information and inadequacies in helping participants to solve a pressing problem meant that participants had to go beyond current solutions of pothole filling.

4. Intense Interactivity

Participants were increasingly becoming aware that chat-GPT had its own limitations in responding to some of the questions: *"*Obviously chat-GPT is unable to give us all answers", commented a participant. Yet, this was a crucial moment when students ought to interact more intensely with chat-GPT to find possible solutions. My observations confirm, the problem with participants at this stage, was that they have rarely been involved in activities that transcend their reproductive thinking box. Intense interaction with chat-GPT was restricted not by capabilities of chat-GPT but by participants' mastery of known knowledge which now proceeded to the use of chat-

GPT within the same reproductive vein. There was a need for epistemic border crossing not at a level of disciplines but at the level of participants' mindset.

5. Maturing

There was, however, greater focus on the project at this stage and participants were able to overcome personal concerns, anxieties, and cynicism. The interview questions focused on how participants felt at this stage of the study. "We are frustrated because chat-GPT answers are for the municipality and we are expected to try out our own solutions*"*. It is important to note that the response relates to a project and no longer on participation and initial use of chat-GPT. This was an important development towards participants' sense of growth and learning.

6. Deep Learning

The frustration with chat-GPT presumed inadequacies which, in essence, emanated from participants' reliance on hard-coded knowledge, although there was a need to explore possible solutions outside this knowledge. Deep learning works on unsupervised forms of learning which is commonly called machine learning capability where AI systems are employed to help resolve real world problems known for their complexity, uncertainty and unpredictability. This was an overwhelming experience for participants and I have had to, as an active netnographic lurker, suggest that participants prompt chat-GPT for innovative solutions to potholes filling and one of the responses included self-healing potholes. This idea fascinated participants who wanted to know more about it. The participants then prompted chat-GPT on self-healing potholes. [These innovative technologies allow potholes to repair themselves without the need for human intervention. Researchers are working on engineering asphalt mixes that have the ability to self-heal. Some studies explore the use of bacteria that produce calcium carbonate]. Participants, in their discussions had a strong propensity to research this area of potholes further and involve Chemistry students. This is how far the study could go with a huge potential for participants to be at the forefront of crafting innovative solutions.

Resolution

This is the stage where participants develop prototypes on the unique idea they have established. In the case of the study, participants would have joined the exploration of self-healing potholes but brainstormed alternative asphalt mixes that do not include the ones suggested by chat-GPT. They could also have calculated the costs of the idea and made their findings public through showcasing. However, participants were unable to reach this stage because of time constraints.

Discussion

The purpose of this study was to develop better understanding of remote learning as a "new normal" in learning and teaching post-pandemic as well as explore possibilities of its advanced form. The data collected in this study is of a qualitative nature making for lack of generality and precision. However, conclusions of this study are relevant and important to IHEs struggling to progress to the next level of remote learning and consider in-person contact sessions as relics of the past. The synchronous remote learning conceptualised within technology-as-utility framework is not sustainable given the impact of AI systems on learning and teaching that increasingly shifts learning control to students. In this study, there was strong indication of students taking active control of their learning through deciding their own project, moments of prompting chat-GPT, discussions, suggestions and probing possible solutions. Post-study interviews with participants show gain in greater control of their own learning. This is the most important and emerging advantage of remote learning. I argue that remote learning would lead to even greater student control when it is conceptualised as asynchronous and AI systems development occurs within technology-as-essence framework. This would enable students to decide when to access educational courses and projects, including from any university, decide on when to take examinations and from anywhere. When questioned post-study on the meaning of this possibility, participants were a bit skeptical. This shows that it takes more time to shift from tradition to new spaces of development. My observations of confident students tackling a real problem and post-study interviews showed a glaring gap between attempts of research and reality as well as the power of institutional cultures. There is a glaring gap in research on AI systems that needs further investigation. For example, the slow embracing of AI systems by participants particularly in terms of infusing them into their practices and the benefits accrued by students when using AI systems.

Participants also showed a positive progression through different stages of team formation process. My observation shows that participants, with minor variations, were able to demonstrate features of each stage of this process. Chat-GPT showed potential in finding innovative solutions to a real problem. Students were also able to sidestep plagiarism by not only rewriting chat-GPT prompts but also included additional information from the textbooks.

Conclusion

The traditional focus of undergraduate studies on mastery of universal hard-coded knowledge mostly bereft of cognitive content of communities of origin or of interest to students require serious attention (McGhie, 2012) given that hard-coded knowledge is already available in AI systems such as chat-GPT. There is no point in trying to take students through this hard-coded knowledge over the stretch of three years when the use of chat-GPT in the first year of undergraduates studies could cover it within a year. Advanced undergraduate studies could then focus on the development of productive thinking through focus on concrete community problems with a strong understanding that learning is socially situated and constructed (Akpan *et al*, 2020). Productive thinking thrives on a Gestalt, holistic approach that concrete community problems offer. Other studies on socially situated and constructed learning

accentuate learning that is a social and cultural process occurring in the context of human relationships and activities. This view assumes that a socio-cultural context should be the basis of student participation in the affairs of their communities, first summon knowledge from within these communities and supplement it with formal hard-coded knowledge (Lave and Wenger, 1991; Akpan *et al,* 2020). The traditional undergraduate studies that focused on "in-the-head" learning that tended to reduce human mental potential to information-processing machine and a storage device with a strong memory strength that contained highly developed retrieval mechanisms has come under intense pressure in this era. AI systems have rendered this approach to learning unnecessary as such knowledge can now be easily accessed via AI systems. The undergraduates' mind can be put to better use which, actually, could play a positive role in their communities. New learning that is suggested in this article referred to as telagogy draws significantly from learning that emphasises students' collaborative effort that leverages their interactions, knowledge sharing, collective research, critical discussions and use of AI systems in attempts to resolve concrete community problems. Telagogy is therefore, an online streaming of educational courses sourced from various universities across the globe and available for access anytime and from anywhere. It makes use of advanced AI systems such as chat-GPT to curate and prepare knowledge for creative complex responsive processes that include localised insights and resources for creative, complex responsive processes. It needs further research and development.

Recommendations

The investigation undertaken in this article was twofold. It sought to better understand students learning from the asynchronous and technology-as-essence framework. The investigation sought to transcend remote learning research that tended to lock its debates on emergency/crisis remote learning implementation during the pandemic. It is suggested that further research is necessary to qualitatively and quantitatively investigate the efficacy of this framing of students' online learning as asynchronous and open to being shaped by continual advances in technology. There is also a need for IHEs to develop guidelines for use of AI systems such as chat-GPT on enhancing students learning. Advanced remote learning offers opportunities for IHEs to shift undergraduate studies away from mimetic epistemologies of replication to *poiesis* with a strong motif of creativity, innovation and complex problem solving. This also shift students' learning from developing reproductive thinking towards productive thinking. The suggestion is that reproductive thinking can be developed in the first-year of students learning and advanced undergraduates ought to increasingly focus on productive thinking. EE research methods also need to be refined to fit into researching learning and teaching.

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Teaching Avatars on Controversial Issues: Lessons Learned

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Abstract

This paper describes and evaluates student teachers' virtual simulation training on teaching a controversial issue. In the fourth year of their program to become social science teachers at lower and upper secondary schools, 43 student teachers in Sweden conducted simulation teaching on conspiracy theories as an example of a controversial issue. Conspiracy theories appeal to young people and they often encounter these theories online, but they can be met with increased knowledge about how conspiracy theories work, and how they can be identified and countered. Thus, students at primary and secondary school need to develop their critical source skills. The Swedish Schools Inspectorate (2022) found that these issues were not properly taught because they were not connected to schools' values-based work or to the development of students' democratic competence. To analyze the simulation teaching, data was collected through observations, video-recorded simulation teaching, interviews with student teachers, and reflective documents. The results show that simulation teaching offers student teachers the opportunity to integrate content knowledge, pedagogical content knowledge, and subject knowledge, by being trained to become flexible and responsive to avatars' individual differences as well as their different attitudes and understanding of the subject.

Keywords: conspiracy theories, controversial issues, simulation teaching, student teachers, virtual practice

The Swedish Schools Inspectorate (2022) found that the teaching of social studies and biology on controversial issues needs to be developed at 21 out of 30 inspected schools. The reasons for this were (a) the students do not have teacher-led conversations about issues that may be controversial, (b) the classroom climate does not favor participation in interaction about controversial issues, and (c) there are gender differences that inhibit girls. They also found that these issues were not connected to schools' values-based work or the development of students' democratic competence. This paper directs attention to the aforementioned factors by investigating simulation training with future teachers of social science on conspiracy theories as an example of content that can be controversial in the classroom (Douglas & Sutton, 2023).

In a complex information landscape with increased access to the Internet and increased information flow, social media feeds conspiracy theories in both democratic and non-democratic contexts. Social media mechanisms – such as followers, likes, shares, tweets, and influencers – designed with a focus on viral effects, whereby users can produce, publish, and share falsified content (Avramov et al., 2020), create a risk of preventing good communication and making reliable information difficult to distinguish from fake news and hoaxes (Bezael, 2022). Önnerfors (2021) argues that conspiracy theories have increased during the pandemic. Conspiracy theories appeal to young people and they often encounter these theories online. However, they can be met with increased knowledge about how conspiracy theories work, and how they can be identified and countered. Thus, students at lower and upper secondary schools need to develop their critical source skills. This includes listening to other peoples' opinions and perspectives that differ from their own values, respecting them, and learning to make well-grounded decisions.

Given the above, we as teacher educators need to reflect upon how future teachers can develop their ability to teach source criticism, controversial issues, and conspiracy theories. Usually, training for such skills and abilities is imparted during teaching practice at schools. However, researchers claim that the training that takes place at schools is insufficient, and as a result student teachers are given too few opportunities to develop their skills and abilities to be able to handle a complex classroom situation (McDonald et al., 2013; Westbury et al., 2005). Campus-based teacher education has a strong focus on concepts, theory, and models that support the development of analytical ability. Knowledge of relevant theories, such as conspiracy theories, in university courses is described as being difficult to connect to the profession and school practice (Lindqvist, et al., 2019). Grossman, Hammerness, and McDonald (2009) emphasize that teacher education needs to help students make this connection. Their argument is that the practical training is insufficient, and that there is also a need to make practical training possible to a greater extent on campus. In this way, the analytical side of the profession and its action-oriented side can be combined (Grossman, et al., 2009; Jank & Meyer, 2004; Ade-Ojo, et al., 2021). A successful method that has been used in an attempt to link the two sides of the teaching profession and bridge the perceived gap between theory on campus and school practice or internship, is simulation training organized as a virtual practice (Samuelsson, et al., 2021).

The aim of this paper is to describe and analyze student teachers' simulation teaching on controversial issues. To achieve this aim, the research question is 'in what ways can teaching in a virtual space develop student teachers' general knowledge, pedagogical content knowledge, and content knowledge about conspiracy theories and promote avatars' critical thinking?'

Background

Research on conspiracy theories is mainly found in the fields of social psychology, political science, history, religious studies, and anthropology (Butter & Knight, 2020; Önnerfors, 2021). This means that only a few research projects have been conducted in education, pedagogy, and social studies. This research shows the value of developing students' understanding of their own and others' values in a multicultural society, but also how the teacher chooses to avoid or embrace controversial issues in teaching (Flensner, 2020). Teachers may find a controversial issue difficult and may hesitate to engage in in-depth discussions for fear of upsetting students and their parents (Kaka, et al., 2021).

In social science subjects, teaching often engages feelings and emotionally challenging discussions. Many discussions involve controversial issues such as politics, migration policy, terrorism, climate change, and so on. Controversial issues are defined by the Council of Europe (2016, p. 8) as "issues which arouse strong feelings and divide opinion in communities and society". These issues raise pedagogical questions for teachers, such as how to create a safe learning environment to prevent friction in the classroom, how to protect the sensitivities of pupils from different backgrounds and cultures, how to encourage active participation, and the role of teacher's own beliefs and values. Sandahl (2020, p. 21) argues: "if we want to contribute to students' citizenship education and give them tools to tackle one-sided viewpoints about the good society, we need to challenge their views."

Leadership in the classroom, often referred to as classroom management, is difficult because the teacher needs to create an open and permissive atmosphere, and encourage constructive student dialogue, including the use of effective questioning strategies (cf. Granström, 2007; Lewis, 2008; Wubbels, 2011). Therefore, it is important to increase student teachers' confidence by teaching them strategies that promote open and respectful dialogue in the classroom and not only obtaining knowledge through course literature and lectures (cf. Kounin, 1970; Alexander, 2008; Hamre, et al., 2013). Hence, in this study the student teachers were trained to perceive, interpret, and make decisions about controversies, such as conspiracy theories, during teaching in a virtual space.

Virtual practice – teacher-led simulation teaching with virtual characters – was an attempt to build student teachers' ability to teach as part of a campus course (Samuelsson, et al., 2022). The training was carried out around difficult but necessary content for teaching, with elements such as fraction calculation or conspiracy theories, in a safe and permissive environment under guidance of knowledgeable teacher educators. Virtual practice reduces complexity and reinforces other aspects of teaching in well-defined exercises of commonly occurring situations

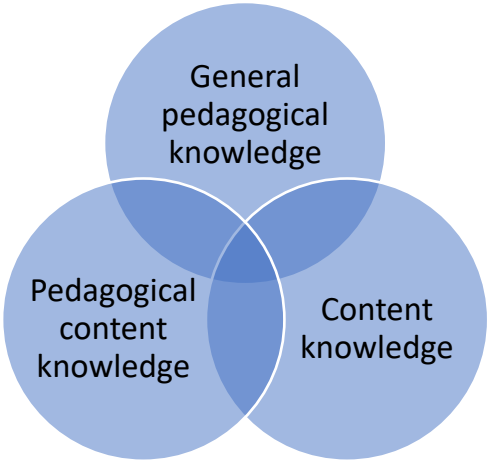
(Arvola, et al., 2018; Mason, et al., 2011). In this way, virtual practice creates a safe environment for learning, which provides the opportunity to try (Dawson & Lignugaris/Kraft, 2017; Ledger & Fischetti, 2019) ways of leading and managing the classroom (Bradley & Kendall, 2014; Piro & O'Callaghan, 2018) without the risk of negatively affecting real students. Virtual practice can augment regular teaching, lectures, and seminars, and can address their lack of precision in terms of action orientation (Dieker, et al. 2014; Bondie, et al., 2021) and strengthen confidence in teaching abilities (Ledger & Fischetti, 2019; Samuelsson, et al., 2021). Research on simulations, virtual practice, and virtual characters as a means to train and develop teaching skills has partly focused on student teachers' self-confidence linked to teaching subject content (cf. Chini, et al., 2016; Ledger, et al., 2019), leadership in the classroom (cf. Hudson, et al., 2019; Smith & Klumper, 2018), or both these aspects (Samuelsson, et al., 2021; Samuelsson, et al., 2022). Usually, student teachers practice the ability to teach as a way of learning how to do teaching. In other cases, simulation training is combined with modeling where the students have previously seen an experienced teacher teach a certain subject matter (Bautista & Boone, 2015). The authors found that modeling has great significance for students' development of teaching, handling challenging students, and being able to answer the avatars' questions in a constructive way. Similarly, various forms of oral and written feedback have positively affected students' confidence in their ability to teach (Gundel, et al., 2019; Samuelsson, et al., 2022). The content and quality of feedback can be described as a key reason why a limited amount of training in virtual practice shows such good results for student development.

Theoretical Framework

To analyze the student teacher's simulation training about conspiracy theories, we used Lee Shulman's (1986; 1987) framework of aspects of a knowledge base for teaching. Shulman divides the knowledge base into (a) content knowledge; (b) general pedagogical knowledge – a broad repertoire of principles and strategies for organization and executing classroom management; (c) curriculum knowledge – a focus on tools such as materials, representations, and programs; (d) pedagogical content knowledge – teachers' converted professional understanding of the content; (e) knowledge of students and their characteristics; (f) educational context knowledge – experience from communities and cultures based on working with groups, in classroom at schools; (g) knowledge of educational ends – a focus on the purpose and values of teaching, as well as their historical and philosophical roots (Shulman, 1987). The categories - educational context knowledge and knowledge of educational ends, knowledge of students and their characteristics, and educational context knowledge were not in line with the course where the simulation training was used and neither the purpose. Those categories were therefore disregarded in the analysis. We focused on three categories – content knowledge, general pedagogical knowledge, and pedagogical content knowledge – both separately and as overlapping issues (see Figure 1).

Figure 1

Aspects of the Knowledge Base for Teaching (Shulman, 1987)



Methodology

The Program

Twenty student teachers in the social science program for lower and upper secondary school started a course worth 15 ECTS in August 2021, and an additional 23 student teachers started in August 2022. This course is the last subject course, including teaching methods, of a five-year teacher training program. The ten-week course focused on controversial issues, critical thinking, the role of the media, digitalization, and assessment. Examinations took the form of oral seminars, written exams, and conducting a project on controversial issues in small groups. However, part of the course also included teaching avatars in the simulation on conspiracy theories and critical thinking. The lecturers prepared the students with literature seminars and lectures on controversial issues, conspiracy theories, populism, and so on. The students planned their forthcoming lesson with the avatars in pairs. The assignment was to plan the first lesson for lower or upper secondary school students on conspiracy theories about the pandemic, vaccinations, fake news, and source criticism. More specifically, the student teachers received the following instructions: Remember that this is the first lesson of the unit, and it is important to create curiosity, motivation, and engagement among your avatars. Divide the lesson between you and your student colleague, and practice before the simulation teaching. You will lead the lesson you planned for 30 minutes, thus 15 minutes per student. After completing the teaching, you will discuss the implementation with the tutors and prepare for the follow-up seminar by writing down your reflections.

The feedback given after each session of virtual practice was arranged with inspiration from the After Action Review (AAR) technique. It was arranged around three questions that each student teacher was asked to answer: (a) what went well, (b) what could have been done differently, and (c) what did you learn from teaching about conspiracy theories to avatars? Questions like these have previously been used successfully adjacent to simulation training

(Scoresby & Shelton, 2014) and in teacher education (Dieker, et al., 2013; Samuelsson, et al., 2021; Samuelsson, et al., 2022).

Simulation Teaching

In order to train the student teachers to perceive, interpret, and make decisions about ideas and conceptions regarding controversial issues such as conspiracy theories, we designed a semi-virtual simulation called *TeachLivE* where they could teach avatars (see Figure 2). The simulation contains several environments including variety of classrooms and avatars, – children, young adults, and adults – with different personalities (Long, 1989; Hayes, et al., 2013). Based on earlier experiences with simulation training (Arvola, et al., 2018; Samuelsson et al., 2022) we thought that TeachLivE and simulation training would serve well for the training of our Swedish student teachers. Other forms of training such as teaching peers with the use of roleplay was not considered, based on to earlier research (Samuelsson, et al., 2021). Simulation with avatars that look and behave like students might provide a more embodied experience than imagining your peers to be your students in role play. The simulation specialist that operate the avatars "stays in character" despite what happens during training while peers might "lose character" due to relational aspects and a sense of play rather than education.

Figure 2

Screenshot from a TeachLivE Session with Five Avatars

Each student teacher had to teach five avatars with different personalities and different ideas about the content. That way they had some knowledge about the learners and their characteristics (Shulman, 1987). The student teachers were also given information about (a) what the avatars could do (interact verbally, carry out non-verbal behaviors, take notes, send, and receive text-messages on their mobile phones, and talk to each other) and (b) what they could not do (leave the classroom or change places).

Before the student teachers entered the simulation, a simulation specialist made elaborate preparations – in collaboration with the authors – in order to represent different commonly occurring ways in which students at lower and upper secondary schools understand, feel about, and reason about the content. The avatars represented and expressed commonly occurring ideas among school students about conspiracy theories (Önnerfors, 2021). The conspiracy theories content that the student teachers were assigned to work with had been constructed and tested with the authors and five teachers teaching in high schools. Based on the results of the testing, the content was adjusted and developed to train the student teachers to teach about conspiracy theories.

The avatars' feelings and understandings were designed as different push-backs (see Table 1), closely aligned to the course goal about what the student teacher was expected to learn and achieve during the teacher training course in social sciences.

Table 1
Push-Backs about Conspiracy Theories

Virtual student	**Push-backs**
Ava	Lack of critical thinking: Is Covid-19 really that dangerous? Brings up Nicki Minaj as a vaccine skeptic influencer.
Dev	Testing the student's knowledge by asking and answering questions based on facts: There are conspiracy theories that turned out to be true. Can we talk more about Trump and QAnon? How about conspiracy theories in the Middle East?
Ethan	Provocative comments: You are all brain-washed, the media obscures reality.
Jasmine	Silent observer: Asks Dev to explain and help her with answers.
Savannah	Sensitive reactions: Should vaccines be mandatory? My grandfather's friend died from Covid-19, it is real.

The simulation specialist acts as a puppeteer and manages each of the five avatars, bringing them to life. This was done simultaneously as the specialist saw and heard the student teachers on Zoom. Such a solution makes it possible for synchronous interaction between the simulation specialist and participants (Dieker, et al., 2016; Ersozulu, et al., 2021). The compliance and response make it possible to adapt the training to student teachers' different abilities, and create a feeling of authenticity, which affects the quality of the simulation (Bondie, et al., 2021).

Data Collection

Data was collected from two student cohorts (2021 and 2022). In total, 43 student teachers majoring in social sciences participated in the study (see Table 2). The researchers observed the simulation while it was ongoing (30 min each session), conducted pair interviews (30-45 min) with student teachers afterwards, and watched the videorecorded teaching sessions. The student pair also compiled reflective notes after the session. In addition, all students met the day after their simulation teaching to sum up their experiences. Notes from group discussions were collected and form part of the analysis. The second cohort from 2022 were also interviewed after all parts of the simulation training.

Table 2
Data Collection 2021 and 2022

Social Science course	Observation & video recording	Interview	Reflection notes	Group discussion notes
2021	20	-	20	5
2022	23*	11	23	5

* Students teach in pairs, but one group had three students. All students taught 15 min/each.

Data Analysis

The analysis is based on qualitative data with the aim of a holistic perspective. Rich data and a systematic search for categories are at the core of qualitative content analysis, and a reduction of data and systematization are important (Schreier, 2014). Five stages of analysis were used. Firstly, individual notes were taken from the observations and the video recordings in the virtual practice. Interviews were transcribed. Secondly, the text was labelled and systematically coded, individually by the first and second author. Thirdly, codes were reduced when they were compared between the researchers, and then categorized. Fourthly, codes and categories were related to the research question and relevant studies. Finally, notes from group discussions were related to each other and included in the categorization. The analysis of the empirical data was presented in three categories in line with Shulman's aspects of knowledge.

Results

The findings are presented based on Shulman's theory of knowledge base for teaching, as described earlier. The empirical data are presented according to the categories: (a) general knowledge, (b) pedagogical content knowledge, and (c) content knowledge. The data sometimes overlap and intersect as Figure 1 shows, but this is also discussed. We illustrate each knowledge aspect with quotations from the interviews, reflective documents, and the notes from follow-up group discussions.

General Pedagogical Knowledge

This aspect of knowledge emphasizes leadership and classroom management. In the simulation teaching, the student teachers created a good atmosphere and a good classroom climate. This was done with a friendly tone and a willingness to listen to the pupils. Our feedback conversations show that the student teachers felt that they learned about their own attitudes and approaches. They said that this was thanks to the alignment of the exercise: first planning the lesson, second teaching in the simulation, third observing peers' teaching, fourth the reflective discussion with a teacher educator, and lastly reflections with the other student in the pair and other students in the class. The overall learning experience for the student is that a teacher must be flexible and responsive: flexible enough to change the lesson plan if the pupils have thoughts and attitudes that can make the teaching more interesting for them, but also responsive in relation to the pupils' sphere of life. This was not done to a high degree in the simulation. Naturally, it can depend on the context and the teaching avatars, but there were opportunities to use the pupils' own thoughts and ideas. Two students mentioned: "There is a balancing act between following your plan and letting the students' thoughts (which may not always follow the plan) take place in the classroom." (Students A and B).

The content was new for the students to teach, but our analysis suggests that they managed the classroom well. The student teachers followed their planning, which established a structure for the lesson, and provided something for the student to hold on to when the pupils tried to maneuver in other directions than planned. However, it is unclear what the pupils understood during teaching. The students did not follow up the objective of the lesson properly, and thus there was no summarizing or conclusion of the learning objective.

One challenge in the simulation teaching involves dealing with pupils' differences in understanding, feeling about, and reasoning about the content. Even though there were only five avatars, it was a clear challenge for the student teachers to manage them. Thus, they experienced difficulties involving all the pupils. The student teachers had obvious problems and a lack of strategies to involve the shy pupil (called Jasmine, see Table 1). They also had problems handling the two boys called Ethan and Dev (see Table 1), who were more interactive than the girls. Once again, this can depend on the simulation itself, whereby teachers cannot approach individual students by sitting next to them, for example. This limited the strategies they could use, but instead of waiting for the shy pupil to answer the question, the teachers went on to another pupil.

Further, the student teachers had unclear actions towards troublesome behaviors, for example, speaking before raising a hand, negative attitudes, disagreement between the pupils, use of mobile phones, or pupils falling asleep during the lesson. One student expressed the following: "I learned about the challenge of distributing the speaking space in a good way between both quiet and more talkative students. There was a particular challenge of getting a quiet student to want to talk." (Student F). Another student wrote: "I learned (got the opportunity to practice) to handle difficult student situations, i.e., when the students got sidetracked or when the students made personal attacks against each other." (Student G).

Hence, one learning experience from the simulation involved encountering both disruptive and quiet pupils.

Pedagogical Content Knowledge

This knowledge form relates to having teaching methods that are appropriate in relation to the age group and its content. In the simulation, the student teachers tried to involve the pupils in the lesson by asking questions. However, there were only questions and answers on an individual level, making it difficult to engage all pupils in the same discussion. The student teachers lacked proper follow-up questions that could give further explanations about what had just been said. The teachers listened to the answers, but rarely used the answers to find out about other pupils' opinions on the same topic. In addition, it was difficult for the student teachers to decide about the relevance of pupils' questions and their answers. As mentioned, there was a willingness to include the pupils, but also a lack of action in terms of deciding when to interrupt a conversation or statement which was irrelevant to the lesson. The reasons for this could be that the student teachers had unclear purposes with the lessons and not enough knowledge of the subject. The subject was not clearly described in the beginning of the lesson and not summarized at the end. In the reflective notes, student C stated: "It is important to know where to go in the lesson in order to stay on topic and limit what is important for this lesson."

Group 3 noted that: "we felt the importance of subject didactics." With that said, the student teachers need to expand their toolbox of methods, giving them a broader repertoire to select from and the possibility to use a variety of methods if the current method does not work well. In the simulation, the methods were questions from the teachers with the pupils answering them individually, and assignments where the pupils followed the pedagogical method "listen – think – pair – share."

Moreover, the pace during the simulation lessons was slow and the content taught in the lessons was on a basic level. The feedback and reflections suggest that the students agreed with this and realized that a lesson must have a different pace and engage with deeper content knowledge.

Content Knowledge

In this knowledge form, the subject's width and depth are important. The student teachers used appropriate language according to the age of the pupils. They used appropriate concepts, but sometimes too academically, and when the pupils did not respond as the teachers wanted them to, they tried to bring the pupils back to the topic (conspiracy theories and source criticism) to develop their learning. However, when the topic itself was too difficult for the student teachers to handle or build a continuation of the lesson on, they more often postponed the difficulties by saying "that's an interesting thought you have, but let us go back to what I have planned today" or "let us discuss that next lesson so I can gather more information, because I am not fully aware of what you are talking about now". The reasons for this avoidance were mentioned

as: “When you don’t have sufficient knowledge about a subject, it is easier to dismiss a student’s thought instead of following it up.” (Students D and E).

Clearly, conspiracy theories have not been taught enough in the education program and its theory courses. However, the student teachers could have been better prepared by studying the content for the simulation lesson more properly. Additionally, the student teachers had difficulties dealing with pupils’ misunderstandings. The student teachers were not firm enough in correcting pupils when the answer was wrong or when they expressed opinions that could be described as “fake news.” Once again, this goes back to a lack of deep knowledge about the subject itself which emerged in the interviews and in the group notes.

Discussion

The simulation teaching about conspiracy theories created an authentic training situation in a safe environment, where the students felt that they could try and learn to act as competent teachers without harming pupils in a school. In this case, our results from two cohorts of student teachers in a Swedish teacher education program are in line with earlier findings (cf. Bradley & Kendall, 2014; Piro & O’Callaghan, 2018). We are extending the previous research on simulation training by incorporating the content of conspiracy theories which has never – as far as we know – been dealt with before (cf. Gundel, et al., 2019; Samuelsson, et al., 2022). The student teachers that were part of the simulation considered the activity in the virtual environment to be both a practical and theoretical exercise (Grossman, et al., 2009; Ade-Ojo, et al., 2021), combining analytical and action-oriented aspects of teaching (Jank & Meyer, 2004). Another useful feature was conversations with university teachers and reflections with peers, which provided opportunities to practice teaching about a content that is mostly taught during school practice in the teacher education programs. The additional practice was appreciated by the student teachers, but in this setting, they were not evaluated, and were rather supported by university teachers who acted as instructors. The student teachers had the chance to receive feedback and feed-forward from the instructors and their student peers, in what felt like a safe space. It was also useful to observe other students teaching the same content to the same pupils. Another learning experience was seeing how others handled difficulties in the classroom and used the AAR technique (Dieker, et al., 2013; Scoresby & Shelton, 2014). One could perhaps have considered other forms of practice, for example, role play with student peers, as another way to train the student teachers. However, simulation was chosen as research comparing role play and simulation training found significant effects in teacher self-efficacy (TEB) when using simulation training (Samuelsson, et al., 2021).

There were many overall learning experiences, pertinent beyond a Swedish educational context. In particular, the student teachers highlighted handling conflicts in the classroom, trying to be flexible as a teacher, allocating speaking space, involving the pupils in the teaching process, and becoming more comfortable and secure as a teacher, which could be understood as general knowledge (Shulman, 1987) or classroom management (Lewis, 2008; Wubbels, 2011). Many student teachers were nervous but appreciated the fact that the content was something they had planned themselves. Still, it was difficult for them to use the avatars’

knowledge in the teaching. Many of the student teachers felt that confirming the avatars' thoughts while also trying to move forward with the lesson was a challenge. We found that the greatest challenge for the student teachers was to respond to the avatars, extending the findings from previous research Samuelsson, et al., 2021; Samuelsson, et al., 2022). The avatars challenged the student teachers with misconceptions, using mobile phones, coming into conflict with other avatars, and not raising their hand when answering a question or when they wanted to talk. In the discussion with the student teachers, they considered this to be an extreme situation; however, as university educators, we do not agree. These are situations that a teacher must be prepared for. In any case, the student teachers realized the importance of seeing their own weaknesses. The student teachers wanted to involve the pupils more in the teaching by relating to the pupils' own lives, but that did not happen. They seemed to lack the tools for creating a high participation format (cf. Kounin, 1970; Alexander, 2008). The reasons given were fear of losing control in the classroom, which stems from a lack of variation in teaching methods, and a lack of deep knowledge in the subject (conspiracy theories). To be more precise, the student teachers seemed to lack content knowledge and pedagogical content knowledge (Shulman, 1987). Another reason was that they found the content (controversial issues) difficult. The student teachers chose to have a friendlier classroom climate rather than risk engaging the avatars in in-depth discussions that could be difficult to handle (cf. Kaka, et al., 2021). Experiencing how difficult it could be to teach about conspiracy theories was an "Aha!" moment for them. They seemed a little surprised about the need to be as secure in content knowledge as in pedagogical content knowledge. However, the most important thing was that they observed how other student teachers handled different situations in the simulation and had the opportunity to reason about this afterwards. Although the student teachers were not completely successful during their limited time in the simulation at getting the avatars to understand different conspiracy theories, source criticism was discussed in-depth with them after the simulation exercise, and the student teachers deepened their subject knowledge by observing their peers and following up on conversations.

A typical lesson structure was that the student teachers described their plan, informed the avatars about classroom rules, gave a lecture, and then held question and answer sessions and/or discussions with the whole class. This was not a sufficiently creative or challenging learning environment for the avatars. The student teachers had good intentions but could not create a classroom climate that allowed all the avatars to participate. In addition, even though there were only five avatars in the simulation practice, not all of them were heard during the lesson. It was notable that although there were only two avatar boys, they were heard more than the three avatar girls. The teachers turned more often to the boys in the classroom and asked for their opinions than to the girls. In that sense, the student teachers reproduced the recent findings from the Swedish Schools Inspectorate (2022) as the student teachers reproduced gender differences that inhibit the avatar girls and had problems to create a classroom climate that supported interaction about controversial issues. This was something the student teachers realized afterwards when the educators asked them about it. Moreover, there was a significant challenge dealing with the shy avatar, Jasmine. Instead of waiting for an answer from her, the student teachers turned quickly to more talkative pupils or those who agreed with the teachers, which felt secure for the student teachers. However, in the simulation,

the students got ideas about solutions by observing peer students' teaching and from the reflective discussions afterwards.

Although our results show promise, there are also limitations to our study. One limitation is the absence of prior research with a similar focus as ours. A more extensive literature review on similar research about simulation training on controversial issues would have provided a solid foundation for understanding the research problem and discussions about contextual similarities and differences. Another limitation is the sample size. Even with twice as many student teacher cohorts, the number of individuals and pairs would still have been small. A larger sample size would have provided more results.

Conclusion

Simulation teaching has its place in terms of offering more teaching practice and creating experiences of acting as a teacher in a realistic situation (cf. Samuelsson, et al., 2021; Samuelsson, et al., 2022). The Swedish student teachers that participated in our study have a total of 20 weeks of school practice spread over the five-year teaching program, and simulation practice seems to be useful addition in between. Simulation teaching can integrate different forms of knowledge: (a) general knowledge, (b) pedagogical content knowledge, and (c) content knowledge. In a safe space, student teachers can develop experiences of authentic practice that combines theoretical and practical aspects of knowledge for the student's development to become a good teacher. In the simulation, the student teachers gained insights into their approaches and an opportunity to test important teaching skills such as flexibility, responsiveness, leadership, using a selection of methods, and demonstrating subject knowledge. In this case, this subject knowledge related to conspiracy theories and developing learning about critical thinking. However, this study reveals that more attention must be paid to teacher education in order to develop student teachers' confidence and their experience of using a variety of methods to motivate and include all pupils, especially when teaching difficult to handle subject matter. To be a skilled teacher, the student teachers need experience and practice offered by simulation teaching. This is a cost-effective and climate-friendly solution for improving student teachers' skills. As the spread of conspiracy theories is a growing phenomenon world-wide, this experience conducting simulation training with TeachLivE to teach controversial issues can be applied to teacher training contexts elsewhere.

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Moroccan Teachers' Perceptions and Concerns about ICT Integration

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Abstract

Integrating technology into teaching practices often changes teachers' work patterns. Thus, several studies have insisted on supporting such change by understanding teachers' concerns. The present study adopts the Concerns-Based Adoption Model (CBAM) as a conceptual framework to examine Moroccan teachers' concerns about integrating information and communications technology (ICT). To this end, we relied on a self-reporting instrument for a sample of teachers (n = 382) from two Regional Academies of Education. Our findings suggest that the overall profile of teachers' stages of concern (SoC) is that of "reluctant" non-users. This profile showed high percentiles for the first three SoC, a low consequence stage percentile, medium percentiles for the management and collaboration stages, and a tailing up at the refocusing stage. Furthermore, the results highlighted a positive relationship between teachers' concerns about integrating ICT and previous continuous training on the one hand and the pandemic's impact on their attitudes toward self-training on the other. In addition, significant differences in teachers' concerns regarding teaching experience and age were found. Our study provides change leaders insight into teachers' concerns about integrating technology which will help the field design appropriate interventions to reduce their limiting concerns.

Keywords: CBAM, COVID-19, ICT, Morocco, stages of concern, teachers

Morocco has made significant efforts to improve the quality of national schools' outcomes. This reform dynamic extends from the National Charter of Education announcement (2000) until the promulgation of framework law 51.17 on the education system (2019). Moreover, integrating Information and Communication Technologies (ICT) into teaching practices and related training were common components of all reform stations. However, the opportunities technology can bring to improve learning quality must be better tapped (The Ministry of National Education, 2022). Such a conclusion raises the question of teachers' training efficiency regarding ICT integration: Does the formal training effectively meet their real needs? Responding to teachers' real training needs to keep up with the change entailed by reform is crucial in ensuring their proactivity (Brinkerhoff, 2006; Magallanes et al., 2022). Nevertheless, professional training is historically designed based on what policymakers assume educators need rather than what they effectively need (Vaughan, 2002). Furthermore, the COVID-19 crisis revealed the important role of technology in teaching and learning activities (Hansson, 2021; Tzankova et al., 2023), and it also highlighted the need for rethinking teachers' professional training in ICT (Stracke et al., 2022).

Based on the Concerns-Based Adoption Model (CBAM) (Hall et al., 1973), the present study examined teachers' concerns about integrating ICT. The study took place in the context of the reform of the Moroccan educational system. Early in the previous year, the Ministry of Education launched national consultations in order to reinvigorate the reform process embodied in law 51.17. Thus, a roadmap for the next four years (2022-2026) was developed based on these consultations (The Ministry of National Education, 2022). This roadmap set 12 commitments needed to enhance the national schools' outcomes. The integration of ICT into teaching practices and related professional development were included in the 2nd , the 6th, and the 9th commitments. Thus, the aim of this study was to understand teachers' needs in terms of technology integration to help in designing appropriate professional development. Furthermore, we think that our study's relevance stems from three other particularities. First, our understanding of ICT continuous training includes not only formal professional development but also the personal effort of self-training that takes place in informal settings. Second, our study integrates the COVID-19 crisis as a new independent variable to examine its potential influence on teachers' concerns about integrating technology. Finally, we followed a rigorous data analysis procedure based on the guidelines proposed by George et al. (2013).

Thus, according to what we mentioned earlier, and by considering the integration of ICT as a source of change, the present study aimed to meet two research objectives: (1) Explore Moroccan teachers' concerns about integrating ICT into their teaching practices and (2) Examine the sensitivity of teachers' concerns toward continuous training in ICT and the teaching experience amid the COVID-19 crisis.

Literature Review

The Concerns-Based Adoption Model

Many studies stressed the significant influence of teachers' feelings and perceptions on their effective integration of technology (Baytar et al., 2023; Fearnley & Amora, 2020; Huang et al., 2023; Njiku et al., 2019). Fuller (1969) was the first to call these feelings and perceptions "concerns." In her theory of concerns, based on a series of studies on student teachers, Fuller believed that teacher education programs should meet their concerns which move theoretically through a four-level continuum: unrelated-concerns, self-concerns, task-concerns, and impact-concerns. Four years later, Hall et al. (1973), relying on Fuller's work, proposed the conceptual framework known as the Concerns-Based Adoption Model (CBAM). This model was supposed to help change leaders identify the concerns of an innovation's implementers in order to facilitate the change process by designing appropriate interventions (Ohlemann et al., 2023). Concerns are defined as "the composite representation of the feelings, preoccupations, thoughts, and considerations given to a particular issue or task" (Hall & Hord, 2014, p. 85). Hence, Hall et al. (1977) built a 35-item questionnaire where they displayed seven stages of concern (SoC) through the four levels suggested by Fuller (1969) (Table 1).

Table 1
Stages of Concern Descriptions

Levels of concern	Stages of concern	Description
IMPACT	(6) Refocusing	The implementer has new and innovative ideas on how to improve/change the innovation's actions.
	(5) Collaboration	The implementer is more concerned about co-work and collaborating with others.
	(4) Consequence	The implementer is more concerned about how the innovation might affect his/her learners.
TASK	(3) Management	All the implementer's interest is focused on preparing materials.
SELF	(2) Personal	The implementer is more concerned about how the innovation might impact him/her.
	(1) Informational	The implementer is curious about gathering information about the innovation.
UNRELATED	(0) Unconcerned	The implementer is not concerned about the innovation; he/she is more interested in other activities or tasks.

According to Hall and Hord (2014), implementing innovation is a source of change, which entails implementers' resistance. Hall and Hord (2014) argued change leaders should understand implementers' concerns in order to reduce their résistance. For them, the apparent

resistance would be just a symptom of "grief" resulting from leaving his/her comfort zone, that is, moving from doing comfortable tasks to implementing new instructions. Thus, they insisted on considering the change as a "process" rather than an "event" to give time for implementers to learn and improve their practices (Hall & Hord, 2014, p. 11).

Related Studies

In conducting our literature review, we were able to distinguish three types of studies: studies that addressed teachers' concerns about ICT integration in general, (e.g., Agormedah et al., 2019; Dele-Ajayi et al., 2021; Dubey, 2016; Sarfo et al., 2017), studies that examined concerns regarding a particular technology after a period of implementation, (e.g., Alnujaidi, 2021; Amankwah et al., 2022; Gu et al., 2023; He & Yusop, 2020), and studies that addressed concerns between two points of time (t_1 and t_2) during a defined period (weeks or months) of a professional development program (e.g., Georgiou & Ioannou, 2019; Kayaduman & Demirel, 2019; Ziegenfuss et al., 2019). Thus, in Dele-Ajayi et al.'s study (2021), the concerns of 340 Nigerian teachers about ICT integration were higher at stages 0, 3, and 1, and lower at stages 5 and 4. Additionally, significant differences were found at the SoC in terms of age, level taught, and teaching experience. Moreover, Dubey's (2016) study suggested higher self-concerns (stages 0, 1 and 2) of 190 in-service teachers about ICT integration with no interesting differences regarding participants' age and teaching experience. In addition, Agormedah et al. (2019) found that the concerns of 66 Business Studies teachers were intense at stages 4 and 1 and low at stage 0, with no significant differences according to teachers' characteristics (teaching experience, age, and gender). Furthermore, as an example of the second category of studies, in Alnujaidi's study (2021), the concerns about "Mobile Assisted Language Learning" of 130 Saudi in-service teachers were intense at stages 1, 2, and 3. The later study highlighted the role of attending previous professional development related to this technology in decreasing self-concerns and increasing impact-concerns (stages 4, 5, and 6). Finally, as an example of the third category of studies, Georgiou and Ioannou (2019) found that the concerns of 31 in-service teachers at the end of a professional development program on "Technology-Enhanced Embodied Learning" were higher at stages 1, 5, and 6. Finally, it is noteworthy that we did not find studies that adopted the CBAM conceptual framework to examine teachers' concerns about integrating ICT within the Moroccan context.

The present study contributes to the research dynamic described above. It relies on the CBAM model as a reliable and valid theoretical framework, used on a large scale, to explore Moroccan teachers' concerns regarding integrating technology. Moreover, our research's particularities, mentioned earlier, will help generate original results that could enrich scientific discussion on technology integration in education as an innovation that entails a change in teaching practices.

Method

Research Design

Our study adopted a quantitative research design to explore Moroccan teachers' concerns regarding ICT integration. After a validation stage with a limited population (17 participants), the SoC questionnaire was used to collect data from elementary and secondary school teachers (n = 382) belonging to two Regional Academies of Education. All data were analyzed using descriptive and inferential statistics.

Participants

Our study population comprised 382 teachers from the three national education system levels: elementary, middle, and high school. Individuals in this sample represented teachers working in two Regional Academies of Education: The Academy of Marrakech-Safi and the Academy of Casablanca-Settat. Participants filled out a questionnaire (described below) with their consent after obtaining our commitment to respect the anonymity of answers and to use their responses for purely academic purposes. Moreover, the research objectives were clear to the respondents. Table 2 displays more details about the participants' demographics.

Table 2
Demographics of Teacher Participants

Variable	Categories	n	%	Variable	Categories	n	%
Gender	Female	170	44.5	Diploma	Doctorate	13	3.4
	Male	212	55.5		Master	86	22.5
Age	20-30 years	102	26.7		Bachelor	238	62.3
	31-40 years	120	31.4		Baccalaureate + 2	26	6.8
	41-50 years	114	29.8		Baccalaureate	19	5.0
	51 and over	46	12.0	Teaching level	Elementary school	135	35.3
Teaching experience	1 - 5 years	111	29.1		Middle school	151	39.5
	6 - 15 years	121	31.7		High school	96	25.1
	16 - 25 years	119	31.2	School subject	Elementary	129	33.8
	26 and over	31	8.1		Scientific	65	17.0
Workplace	Rural	140	36.6		Literary	168	44.0
	Urban	242	63.4		Activity	20	5.2

Instrument

As detailed earlier, our study adopts the CBAM conceptual model to examine teachers' concerns about integrating ICT. Hence, our survey's instrument was the 35-item questionnaire elaborated by Hall et al. (1977) and published by George et al. (2013, pp. 27–28). Thus, to adapt the questionnaire statements to our research objectives, we substituted "innovation" with

"ICT." The 35 items of the questionnaire are divided into seven stages of five items each. The answer to the items is made according to a seven-option Likert-scale (0 = Irrelevant; 1 and 2 = Not true of me now; 3,4, and 5 = Somewhat true of me now; and 6 and 7 =Very true of me now). Besides the 35 items, we added questions about participants' demographics and two Yes/No questions designed to address the second research objective. The first such question asked, "Have you received any training in using ICT, whatever form it takes (in a formal or informal setting)?". The second question asked, "Given that the COVID-19 crisis did highlight the importance of using ICT, did you make a self-training effort to develop your competence in using ICT after the outbreak of this crisis?"

The questionnaire was administered in Arabic. Thus, a translation validation was needed. As a first step, the researchers collaborated with an English teacher, who had experience using ICT, to translate the original questionnaire into Arabic, taking into account the participants' culture. Subsequently, two other English teachers with the same profile scored the previous translation's accuracy based on a 10-point grade for each item and suggested rectifications, if any. Consequently, the questionnaire items scored between 8 and 10. The researchers and the first English teacher discussed the items, suggested rectifications, and made necessary changes. Moreover, the researchers pretested the revised questionnaire among 17 participants to check its clarity and appropriateness.

As for the questionnaire's internal reliability, the overall Cronbach's α coefficient was .959, and Cronbach's α coefficient of the seven SoC ranged from .588 to .896 (Table 3). An outstanding remark noted during our literature review is the low Cronbach's α coefficient of Stage 0 found in most studies, (e.g., Hall et al., 1977; Ashrafzadeh & Sayadian, 2015; Alnujaidi, 2021). Generally, the high Cronbach's alpha coefficients found for our instrument were deemed satisfying.

Data Collection and Analysis

The data collection was performed through two modes: paper-and-pencil and online format. Within the final sample (n =382), 73 (19.1%) paper and 309 (80.9%) online questionnaires were deemed valid. As for the data analysis, SPSS.22 software was used to make the analysis necessary to meet the two research objectives. Furthermore, as mentioned earlier, a rigorous data analysis and interpretation procedure, recommended by George et al. (2013), was followed. To illustrate the overall profile of concerns, we first averaged the seven stages' raw scores and then converted the averages to percentiles. To this end, we built a program in Excel to convert raw scores to percentiles. As for the inferential statistics, we used raw scores instead of percentiles.

Table 3
Cronbach's Alpha Coefficient by Stage

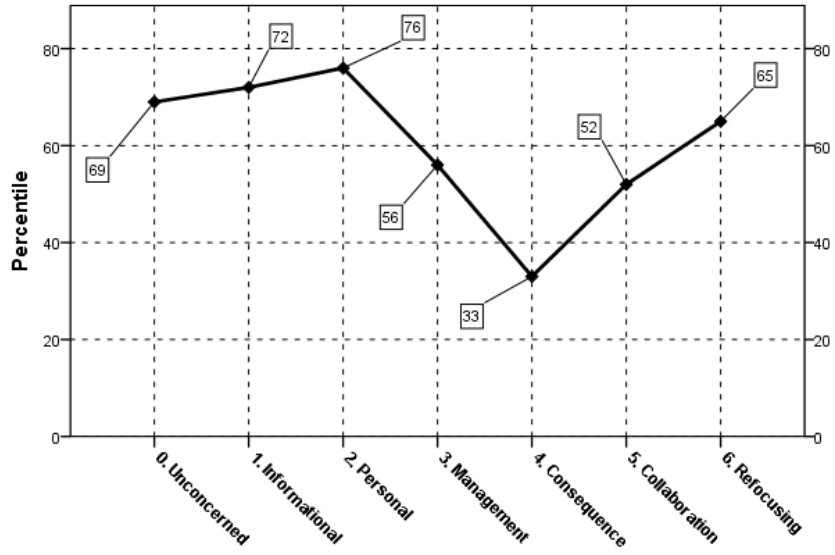
Stage	*C.α.C	Stage	*C.α.C	Stage	*C.α.C
Stage 0	.588	Stage 3	.754	Stage 5	.896
Stage 1	.812	Stage 4	.878	Stage 6	.855
Stage 2	.891				

Results

Teachers' Overall Stages of Concern Profile

The teachers' overall SoC profile (Figure 1) showed, at first sight, that the first three stages (unconcerned, informational, and personal), were the highest stages. Among these three stages, the personal stage had the highest percentile (76th), followed by the informational stage (72nd), and finally, the unconcerned stage (69th). In addition, the overall profile suggested that the lowest stage of concern was stage 4 (consequence), with a percentile score of 33rd. Moreover, medium intensities were recorded for stage 3 and stage 4 (56th and 52nd consecutively). Finally, a remarkable feature of this profile was the "tailing-up" of the refocusing stage (the 65th).

Figure 1
Teachers' Overall SoC Profile



Furthermore, the overall profile reflected only the average percentiles scores of the SoC questionnaire. Therefore, we could not infer from this profile the teachers' distribution according to their percentiles' frequency (for instance, through quartiles) as well as their distribution according to their highest stage of concern. Thus, for improved visibility of our results, Table 4 and the Box Plot (Figure 2) provide more details on these two later types of distribution.

Table 4

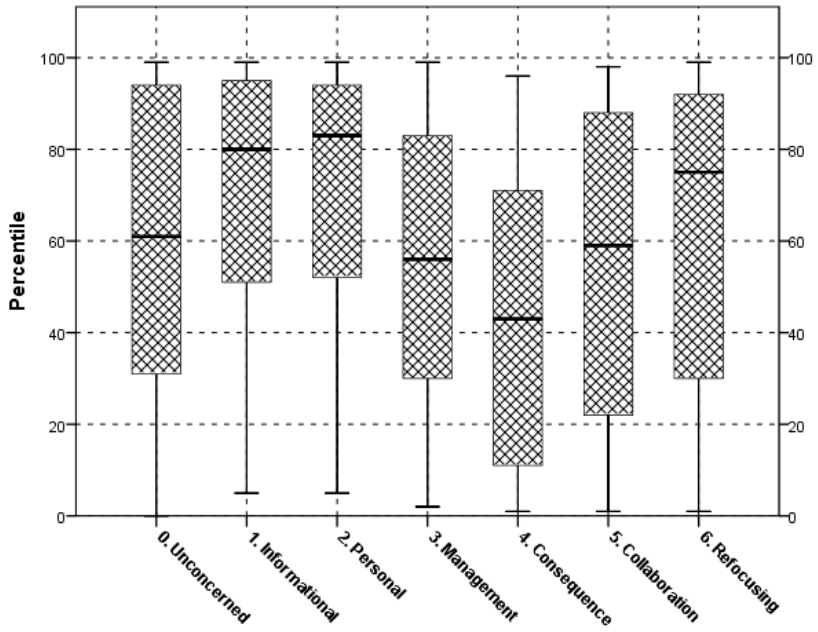
Distribution of Teachers' Highest Stage of Concern

	0	1	2	3	4	5	6	Total
n	106	119	91	24	4	22	69	438*
%	12.9	27.2	20.8	5.5	0.9	5	15.8	100

Note. * The highest percentile is replicated over two or more stages for some participants.

Figure 2

Distribution of Teachers by Percentile Frequency (Quartiles)



Relationship between Teachers' Stages of Concern and the Main Independent Variables

By using Student's *t*-test, our results highlighted statistically significant differences ($p<0.05$) in the teachers' concerns regarding ICT integration according to two variables, namely ICT training and the impact of the COVID-19 crisis on their attitude toward self-training in the field (Table 5). Hence, teachers who previously received training in ICT, regardless of its form or source, were more concerned about consequence, collaboration, and refocusing issues (Figure 3). Moreover, the results suggested that teachers who replied "Yes" to a question about the positive impact of the COVID-19 experience on their self-training efforts to improve their capability to integrate ICT meaningfully in their classrooms had more concerns in five of the seven stages of the questionnaire: Informational, Personal, Consequence, Collaboration, and Refocusing stages (Figure 4).

Furthermore, our statistical analysis using an one-way ANOVA test revealed a significant relationship ($p<0.05$) between the SoC and two other variables, namely participants' teaching

experience and their age (Table 6). Regarding teaching experience, there were statistically significant differences in the unconcerned, informational, personal, management, and collaboration stages. As for age, significant differences were recorded in the unconcerned, informational, personal, management, and consequence stages.

Table 5

Comparison of Teachers' SoC Means by ICT Training and COVID-19 Impact

Stages	ICT training	n	M	Sig. (*t*-test)	COVID-19 impact	n	M	Sig. (*t*-test)
Stage 0	Yes	214	11.88	.241	Yes	312	12.14	.505
	No	168	12.73		No	70	12.76	
Stage 1	Yes	214	20.26	.731	Yes	312	20.91	.021*
	No	168	20.58		No	70	18.14	
Stage 2	Yes	214	21.67	.653	Yes	312	22.12	.009*
	No	168	21.20		No	70	18.56	
Stage 3	Yes	214	15.12	.369	Yes	312	15.59	.615
	No	168	15.93		No	70	14.97	
Stage 4	Yes	214	22.39	.005*	Yes	312	22.05	.000*
	No	168	19.49		No	70	16.96	
Stage 5	Yes	214	22.68	.001*	Yes	312	22.21	.000*
	No	168	18.93		No	70	15.77	
Stage 6	Yes	214	21.72	.000*	Yes	312	21.09	.000*
	No	168	17.85		No	70	15.24	

Figure 3

Teachers' SoC by Previous ICT Training

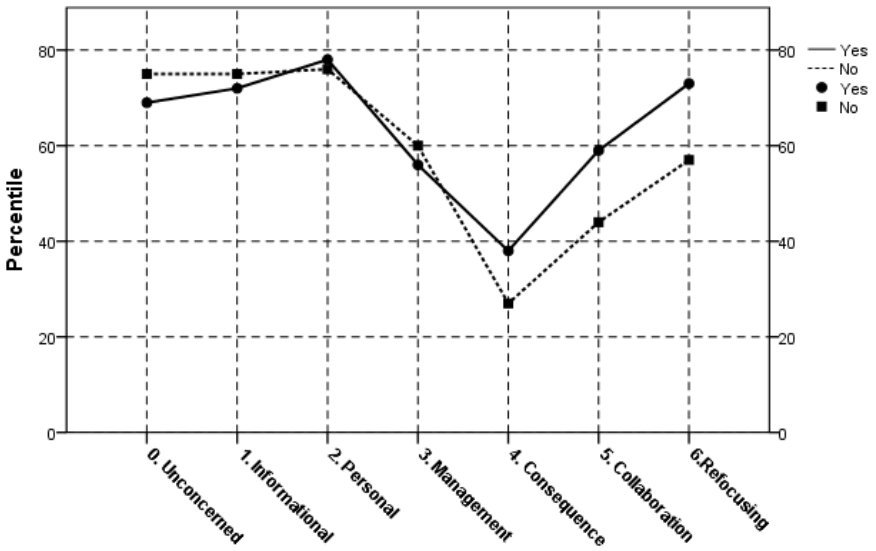


Figure 4

Teachers' SoC by the Impact of the COVID-19 on their Self-training Efforts

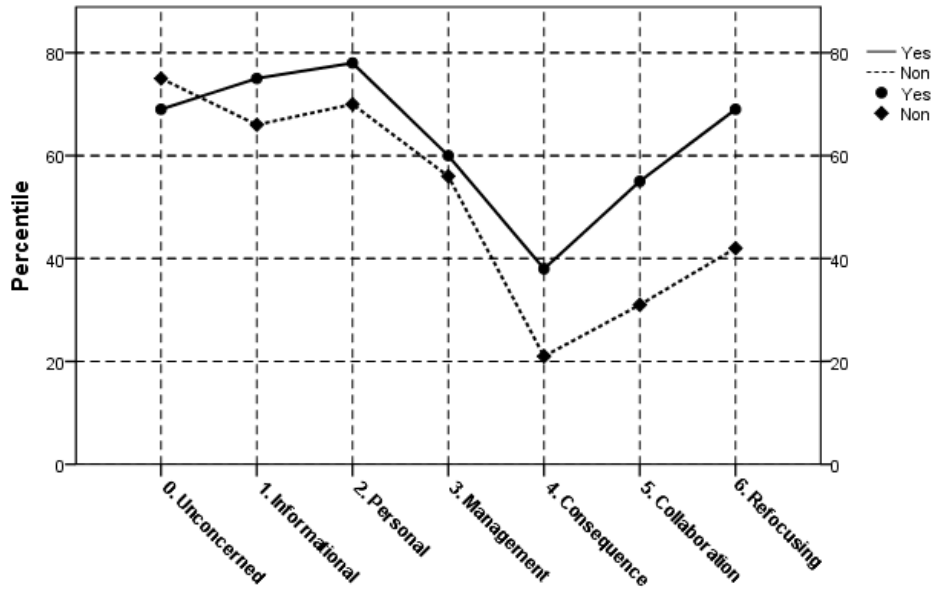


Table 6
Comparison of Teachers' SoC Means by Teaching Experience and Age

Teaching Experience			Age		
Stages	**F**	**Sig.**	**Stages**	**F**	**Sig.**
Stage 0	5.328	.001*	Stage 0	4.478	.004*
Stage 1	3.934	.009*	Stage 1	3.069	.028*
Stage 2	3.789	.011*	Stage 2	3.169	.024*
Stage 3	4.110	.007*	Stage 3	3.654	.013*
Stage 4	2.424	.065	Stage 4	2.866	.037*
Stage 5	2.884	.036*	Stage 5	2.085	.102
Stage 6	1.937	.123	Stage 6	1.887	.131

Moreover, for an in-depth analysis of the results arising from the ANOVA test, a Post Hoc test (the Least Significant Difference test) was carried out. Thus, without reporting detailed statistics, the general conclusion highlighted for the teaching experience variable was that the more teaching experience, the less concerned the teachers were, especially for the two extreme groups (1-5 years and over 26). Although the ANOVA test did not reveal significant differences for the consequence and refocusing stages, the Post Hoc test did between the extreme age groups. This conclusion is well illustrated in Figure 5. In addition, the Post Hoc test results suggested a similar trend regarding the age variable. That is, the younger the teachers, the higher the intensity of concerns (Figure 6). Differences were significant for extreme age groups (20-30 and "51 and over") over all SoC, including the collaboration and the refocusing stages, where the ANOVA test *p*-value was not significant.

It is noteworthy that no significant differences were suggested for the other independent variables, namely gender, teaching level, workplace, school subject, and diploma.

Figure 5

Teachers' SoC by Teaching Experience

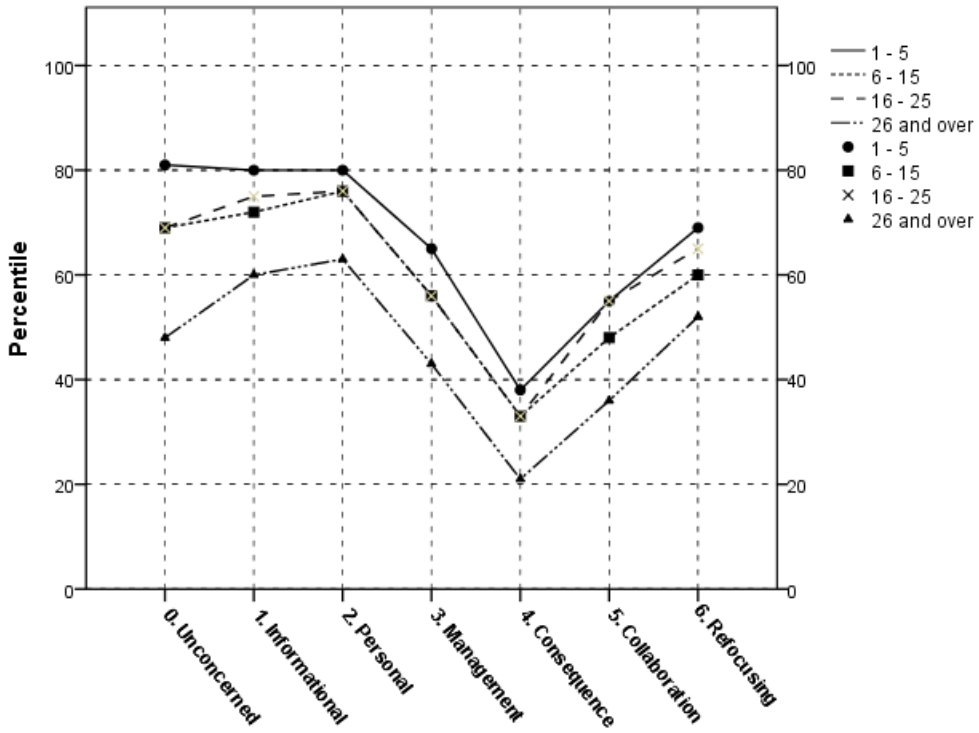
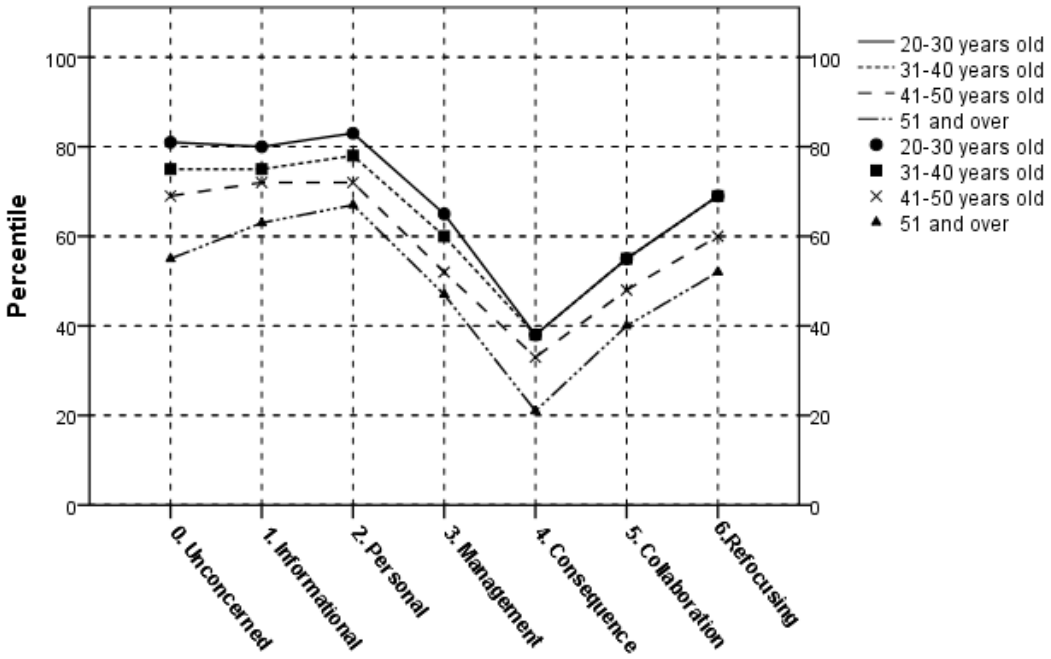


Figure 6

Teachers' SoC by Age



Discussion

In the present study, we attempted to explore Moroccan teachers' concerns about ICT integration in their teaching practices (Objective 1). In addition, we examined whether these concerns were sensitive to continuous training in the field and the experience of teaching amid the COVID-19 crisis (Objective 2).

To interpret the teachers' overall profile of concerns illustrated in our findings (Figure 1), we refer to the guidelines recommended by George et al. (2013). This profile showed high percentile scores for the three first SoC, that is, stage 2 (76th), stage 1 (72nd), and stage 0 (69th). First, the participants' high personal percentile score suggests they were more concerned about self-issues like professional status, promotions, and personal privileges. In other words, they were most concerned about how ICT might impact them. Second, the high informational percentile score shows, in turn, that the participants were curious about the features and requirements of ICT integration. Participants with high informational stage scores were not bound to be knowledgeable, but they were rather curious people who wanted to know more. The high stage 1 and stage 2 scores find their explanation in other studies, combining them into one stage because of their strong correlation (Bailey & Palsha, 1992; Cheung et al., 2001; Shotsberger & Crawford, 1999). Likewise, many other studies found high and close stage 1 and 2 scores (Alnujaidi, 2021; Ashrafzadeh & Sayadian, 2015; Dubey, 2016; Gu et al., 2023; Masarweh, 2019; Yang-Hsueh & Syh-Jong, 2014). Moreover, the fact that the personal stage score is higher than the informational stage score would indicate a potential resistance toward ICT integration. Third, the participants' high unconcerned stage scores indicated that the integration of ICT was not a priority for the participants. They were not interested in using ICT; they would be more engaged in other activities or tasks. In sum, high scores in the three first stages generally characterized the non-user profile.

Furthermore, the lowest consequence stage score (33rd) indicated that the participants were less concerned about the effect of their ICT use on their learners. It is an alarming finding for the Ministry of Education, which had placed the learner at the center of the new reform's actions (The Ministry of National Education, 2022). Likewise, the consequence stage score was the lowest in other studies (Alnujaidi, 2021; Ashrafzadeh & Sayadian, 2015; Dele-Ajayi et al., 2021; Dubey, 2016; Georgiou & Ioannou, 2019). Nevertheless, in Sarfo et al.'s (2017) study, consequence concerns about integration ICT had the second highest score. In addition, our findings suggest medium scores in the management and collaboration stages. These findings indicate a relative interest in managerial issues, like logistics and time, and in collaborating with others. Hence, From the previous analysis of the first six stages, we could infer that the typical profile of our sample was that of a non-user. Additionally, the tailing up of the refocusing stage score highlighted valuable information about teachers' typical profile; despite having innovative ideas, teachers were reluctant to integrate ICT. Thus, this tailing up emphasized the hypothesis, raised previously, of the participants' resistance toward ICT integration, and it "[…] should be heeded as an alarm" (George et al., 2013, p. 42). Being able to use ICT is necessary, but it is not a condition for effectively integrating them (Sandholtz & Reilly, 2004). Dubey (2016) found an overall profile shape close to ours.

Regarding continuous training in ICT, our findings suggest that teachers who have previously received such training have significantly higher impact-concerns than teachers who have not. Adams (2002) found positive correlations between training in ICT and impact-concerns. In addition, most studies that have addressed professional development in a particular technology found shifts from self-concerns to impact-concerns at the end of this professional development (Alnujaidi, 2021; Kayaduman & Demirel, 2019; Vaughan, 2002); the professional development mitigates participants' self-concerns and accentuates their impact-concerns. In our study, the absence of significant differences in self-concerns could be explained by the wide range of technologies that the acronym ICT refers to as innovation. That is, participants need more information about technologies and about how they can affect them. On the other hand, lecturing about a particular technology within a professional development program provides answers to participants' questions about their self-concerns. Furthermore, participants who think the COVID-19 experience raised their self-training efforts regarding ICT integration have significantly high informational, personal, consequence, collaboration, and refocusing concerns. That is, this experience aroused their curiosity about ICT and made their practices more sophisticated. The COVID-19 experience has positively impacted teachers' attitudes about using ICT (Baytar et al., 2022). Furthermore, our findings suggested significant differences in teachers' SoC regarding teaching experience and age. Recent hires and young participants were more concerned than experienced and older teachers. Adams (2002, p. 285) inferred that "[…] young faculty and faculty with less teaching experience expressed higher-order concerns". In contrast, more experienced and older teachers had deeper concerns over most of the stages in other studies (Alnujaidi, 2021; Dele-Ajayi et al., 2021).

Conclusion

The ongoing advance of technology, as well as its significant contribution to ensuring pedagogical continuity during the COVID-19 crisis, would explain the outstanding presence of ICT integration in education in the current scientific research. The researchers have addressed the teachers' ICT integration from many perspectives to examine how they use technology to improve their teaching. In the same context, our study adopted a quantitative approach to examine Moroccan teachers' concerns about using technology.

Hence, our finding suggested that the teachers' overall SoC profile is that of "reluctant" non-users. This profile showed high percentiles for the first three SoC, a low consequence stage percentile, medium percentiles for stages 3 and 5, and a tailing up at the refocusing stage. Moreover, the findings highlighted a positive relationship between teachers' concerns about integrating ICT and continuous training in technology on the one hand and the pandemic impact on their attitudes toward self-training on the other. In addition, our results showed significant differences in teachers' concerns regarding teaching experience and age.

Furthermore, the results of this paper do not claim exhaustiveness. We are aware of the limits of our approach related chiefly to our sample's non-representativity of the entire schools of the country and the risk of getting subjective responses from using a self-perception instrument. However, we think that our findings propose a theoretically framed diagnosis that could help

policymakers obtain answers to some questions related to the integration of technology in Moroccan public schools, especially as the study takes place in a context where the Ministry of Education is initiating its efforts to implement the twelve commitments of the Roadmap 2022-2026. Moreover, as further research, our study's approach would be used to understand teachers' concerns about particular technologies' implementation with a limited number of participants to address not only the overall profile of concerns but also look into every participant's concerns to design subsequently appropriate interventions according to the individuals' needs. In addition, for a successful implementation of change, the concerns of change leaders need to be addressed as well.

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Rethinking Education: An In-Depth Examination of Modern Technologies and Pedagogic Recommendations

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Abstract

Educational technology has changed the teaching and learning process in many ways. As teachers needed new strategies to adapt to emerging technology tools and to interact with students, immediate feedback and digital instructional resources had become the norm. Teaching and learning expectations are growing because of technological improvements. Many digital libraries and online resources are now easily accessible to teachers and students. Therefore, a qualified teacher must be aware of the new teaching requirements and the adjustments related to educational technology trends. Additionally, it is important to adopt a Technological Pedagogical Content Knowledge (TPCK) framework and to clarify how teachers and students can collaborate to achieve learning outcomes through updated educational practices. This collaborative education can occur because technology makes it easier for students and teachers to interact together, despite the physical distance that could separate them. This paper emphasizes the optimum use of educational technologies and the potential of new digital tools that have already been exploited in an unprecedented way. It aims to provide a comprehensive review of current technologies with pedagogic recommendations, to highlight the importance of educational technologies in teaching, and to reconsider strategies for acquiring digital skills in the Artificial Intelligence era. The discussion revolves around identifying and depicting various advanced educational technologies that can be integrated with engaging pedagogical approaches. Furthermore, it explains how each technology can enhance the learning experience, emphasizing the teacher's role in the technology-based educational process.

Keywords: active/interactive learning, education, student-centred approach, teaching strategies, technology, technology-based education

The teaching and learning process is currently undergoing adjustments. How students learn and how knowledge is transmitted globally have both been significantly impacted by the pace at which technological innovations can bring about changes in pedagogy. The use of new and developing technologies is creating challenges to both the traditional approaches to education and instruction as well as the structure of the educational system. Despite the substantial influence of information technology on educational studies and developments, instant access to a wide range of data makes it challenging to assess information. Therefore, modern technology provides a wide range of tools for improving education in the digital age. The adoption of audiovisual instructional devices by teachers is currently recommended, and the variety of educational materials is always growing.

This paper aims to explore the integration of technology in K-12 classroom setting through the lens of Technological Pedagogical Content Knowledge (TPCK). The primary focus is on how technology can be harnessed to support a student-centered learning environment. By examining the intersection of technology, pedagogy, and CK within the TPCK framework, this study elucidates how educators can effectively leverage technology to create engaging learning experiences that prioritize the specific needs of students. The rationale behind this focus lies in the significance of nurturing a technologically enriched learning environment that not only caters to students' diverse learning styles but also prepares them to thrive in an increasingly digital and interconnected world. Emphasizing the K-12 setting within the TCPK framework is crucial as it provides a targeted and tailored approach to address the unique challenges and opportunities present in primary and secondary education. Ultimately, this exploration aims to empower educators with the knowledge and strategies needed to use technology's potential effectively and create impactful educational experiences for students.

Many studies have been conducted on education and technology, specifically after the COVID-19 pandemic due to the huge shift of education to online learning. However, technology in education has always been an area of discussion and exploration. In a study published in 2003, Linn argues that there appears to be no end in sight for the number of technological tools that are being invented. They have also altered the method in which we interact with one another and how we perceive the environment. In another study, Oliver (2005) demonstrates how the integration of digital technology into educational settings has resulted in positive shifts and developments in today's educational environment. Alkhamisi and Monowar (2013) reveal how augmented reality enhances one's view of the real world by superimposing digitally generated visual, audio, or other sensory information. They reckon that technology can help students better capture their ideas, which will ultimately improve their educational qualifications, and that the scope of its influence has a positive impact on the ways in which students learn and collaborate with their instructors. Turgut and Aslan (2021) discuss that there are now more opportunities for the dissemination of learning material and for gaining access to it because of the proliferation of new communication channels brought about by the internet.

Many of the previous studies highlighted the importance of using technological tools as a means of delivering information in the teaching and learning process. This integration of technology into education falls within the realm of TPCK, which emphasizes the critical

interplay between technological, pedagogical, and content knowledge. However, there is a research gap in the literature in studies highlighting the importance of applying different pedagogical approaches centered on the learner using technology and informed by TPCK. Therefore, our discussion focuses on the different pedagogical approaches infused with TPCK that can be used in combination with educational technologies, and how each approach can be used to enhance the learning experience and improve student learning outcomes. We will start our discussion with a theoretical framework about TPCK and a review of the literature, then we will discuss the importance and ways of using technology in teaching strategies as well as the importance of the teacher's role in technology-based education. We will conclude our study by highlighting the role of technology in enhancing a student-centered learning environment and by providing recommendations for future studies.

Theoretical Framework

TPCK is a theoretical framework that intricately weaves three vital components in education: technology, pedagogy, and content knowledge (CK) (Mishra and Koehler, 2006). TPCK emphasizes integrating technology to enrich teaching and learning experiences significantly.

The TPCK framework comprises seven factors, each defining a specific aspect of teacher knowledge for effective technology integration. These components include technology knowledge (TK), referring to knowledge about various technologies; CK, which involves understanding the subject matter to be taught; pedagogical knowledge (PK), encompassing teaching methods and processes; pedagogical content knowledge (PCK), blending content and pedagogy for better teaching practices; technological content knowledge (TCK), understanding how technology can create new representations for content; technological pedagogical knowledge (TPK), knowledge of using technology in teaching; and technological pedagogical content knowledge (TPACK), the integration of technology in any content area.

The TPCK framework emphasizes the importance of teachers having a deep understanding of the interplay between content, pedagogy, and technology to enhance student learning effectively. This understanding serves as a foundation to devise context-specific strategies and representations tailored to individual circumstances. For technology integration to be productive in teaching, it must holistically address the three key elements, recognizing their interdependent relationships within the system (Mishra and Koehler, 2006). Educators with well-developed TPCK can select appropriate technology aligned with learning goals, design engaging lessons that promote active learning and critical thinking, cater to diverse student needs, facilitate assessment and feedback through technology, and foster 21st-century skills such as creativity and collaboration.

This paper presents a comprehensive examination of technology and its role in successful teaching and learning. The discussion provides insights into the development of TPCK through continuous professional development, fostering a growth mindset, and implementing various strategies. Specifically, it offers practical tips on how each technological tool can be effectively utilized in the teaching process to enhance student engagement, improve learning outcomes,

and create personalized and differentiated learning experiences. The focus is to empower educators to leverage TPCK to establish engaging, student-centered learning environments that foster academic success and nurture essential 21st-century skills.

Literature Review

Learning may now be achieved rapidly, and all individuals can receive education in the age of digital technology, which also coincides with the new era of multimedia tools and web networks. The quality of education is supported by new technologies, and more people are given opportunities to learn. Sharing information and enhancing one's ability to communicate are two key aspects of education. Students are more likely to work well together and develop excellent communication skills when they have access to technology. Online collaboration between teachers and students allows for the completion of any project or task. In educational broadcasting, for instance, the utilization of technological instruments as well as recording systems based on computer technology are all important factors. Learners who are unable to attend classes have a better chance of accessing education using distance learning. "The Internet of Things (IoT) is proven to be one of the most cost-effective methods of educating young brains. It is also a robust mechanism for integrating a world-class learning experience for everybody." (Haleem et al., 2022, p. 275) This is certainly relevant for individuals who are home schooled.

In a review of the literature from 1996 through 2008, Means et al. (2010) reported that students in online learning conditions generally performed moderately better than those receiving face-to-face teaching. However, despite this advantage, Mishra and Koehler (2006) argued that simply adopting technology in pedagogical approaches is not enough; rather, they stressed the necessity of developing TPCK, a complex, situated form of knowledge that intertwines content, pedagogy, and TK. While TPCK holds promise, the study published in 2009 recognized the complexity of teaching and the challenges posed by technology integration, indicating the need for a nuanced understanding of the interplay between these domains. Voogt et al. (2013) conducted a systematic literature review, unveiling diverse interpretations of TPCK and technological knowledge, raising concerns about its measurement and emphasizing the importance of subject-specific TPCK understandings. Moreover, Herrington and Kervin (2007) cautioned against ad hoc technology integration, advocating for teachers to adopt technology as cognitive tools to empower students in authentic learning experiences. Nonetheless, the role of teachers remains crucial in providing clear purpose and support for technological integration. The same idea has been explored by Hew and Cheung (2013) in a study emphasizing that the positive effects of Web 2.0 technologies are not solely attributed to the technologies themselves but rather to how they are utilized and conceptualized in the learning process. Meanwhile, Bower et al. (2015) stressed the importance of designing rich-media synchronous technologies for active learning in face-to-face instructions, highlighting considerations of communicative requirements and cognitive load. However, Alharthi's study in 2021 revealed university students' difficulties in using technological tools and emphasized the need for training before taking online courses. Furthermore, the study highlighted the limited use of diverse online activities in university courses, warranting a comprehensive

approach to technology integration in education. While highlighting the widespread acceptance of technology in education, Akram et al. (2022) also identified numerous barriers to effective technology integration, necessitating solutions to resource constraints, lack of leadership support, inadequate infrastructure, and other challenges.

From the above-mentioned examples, the existing literature on technology integration in education primarily focuses on examining the limitations of technology in the classroom. Moreover, numerous studies have concentrated on the shift to online learning, utilizing technology primarily as a means of communication between teachers and students. However, there is a noticeable gap in the literature regarding the necessity of transforming the educational paradigm to keep pace with technological advancements in the context of TPCK. This limited perspective fails to explore the full potential of technological tools beyond communication and their integration within TPCK's dynamic framework. To address this gap, it is crucial to investigate adapted teaching strategies that harness the potential of technology to actively engage students in the learning process while aligning with TPCK principles. In response to this need, our present research sheds light on teaching strategies that effectively incorporate technological tools within the TPCK framework to create and sustain student-centered learning environments.

By conducting this study with a focus on K-12 students and educators, we aim to bridge the gap in the literature and emphasize the integration of technology within TPCK. Our goal is to contribute significantly to the development of effective and forward-looking educational practices that harness technology's transformative power to its fullest extent in the K-12 classroom setting. Through this approach, we strive to empower educators with insights and strategies that can effectively create student-centered, technology-enhanced learning environments for K-12 students, fostering their active participation and success in the educational process.

Engaging Teaching Strategies Using Technology

Engaging teaching strategies start with designing the classroom having the students in mind. The active/interactive learning strategy encourages students to discuss, participate, investigate, and create. It challenges them by questioning them, requiring problem-solving and critical thinking. Adopting this strategy starts by shifting from the traditional classroom setting to the roundtable classroom setting. The latter encourages interactive learning, face-to-face accountability, and verbal immediacy (Parsons, 2017). In addition, active/interactive learning increases the students' CK (see Menekse et al., 2013) and contributes to co-inferring new information with the help of input from one's learning partners enabling students to co-create knowledge (see Chi and Wylie, 2014). While changing the classroom setting can provide a conducive environment for active/interactive learning and a student-centered approach, it is not enough on its own. The success of active and interactive learning largely depends on the instructional strategies and techniques used by the teacher. The teacher needs to use pedagogical approaches that encourage inquiry-based learning, critical thinking, and problem-solving skills. Additionally, integrating technology and multimedia resources into the learning

process enhances active/interactive learning and promotes student-centeredness within the context of TPCK. Therefore, a combination of classroom design, instructional strategies, and technological tools helps create a more engaging and student-centered learning environment. We will focus on the use of active/interactive teaching strategies in the K-12 classroom and the adapted technological tools that further enhance students' engagement.

Brainstorming

Brainstorming is a commonly used technique in education where a group of students work together to generate and share ideas related to a particular topic or problem. The primary goal of brainstorming is to encourage creativity and critical thinking by allowing students to freely express their thoughts and ideas without fear of judgment or criticism. During a brainstorming session, the teacher can collect students' ideas and facilitate a discussion that encourages students to share and respond to each other's ideas. This helps create an open and inclusive learning environment where students can learn from each other and build on their collective knowledge. Moreover, brainstorming allows the teacher to assess the students' prior knowledge and understanding of a topic. By gathering information about what students already know, the teacher can tailor the instruction to meet the needs of individual learners and provide input on what they do not know. Brainstorming can be conducted in various formats, such as verbal discussions, written notes, or using technological tools such as Tricider, AnswerGarden, or MindMeister. When using Tricider[1], the teacher creates a board and invites students to submit their ideas on a topic or problem. The board can be shared with the whole class, and everyone can see and vote on each other's ideas. The teacher can also use the voting feature, which allows students to vote on the most important or relevant ideas. Once the brainstorming session is complete, the teacher can use Tricider to facilitate a discussion on the ideas generated. Students can comment on each other's ideas, and the teacher can provide feedback and guidance. AnswerGarden[2] is another tool that could be used in this teaching strategy. The teacher creates a simple questionnaire and asks students to add words they know related to the topic. These words are displayed on the teacher's board as they are added in the form of a word cloud. The size of each answer in the word cloud depends on how frequently it has been submitted by the students. This makes it easy for the teacher to quickly identify the most common responses and themes. MindMeister[3] is also a tool that could be used for brainstorming, and to organize ideas into themes. The teacher creates a mind map of a topic and asks students to join it and contribute their ideas. Moreover, the teacher can use the voting feature to have students vote on the most important or relevant ideas. This contributes to narrowing down the focus and identifying the most important points for further discussion. Once the brainstorming session is complete, the teacher presents the mind map to the class to summarize the ideas generated during the session. This helps students understand the thinking process behind the ideas and provides a visual representation of the brainstorming session.

[1] Tricider: https://www.tricider.com/
[2] AnswerGarden: https://answergarden.ch/
[3] MindMeister: https://www.mindmeister.com/

Regardless of the format, the key to successful brainstorming is to create a safe and supportive environment that encourages open and honest communication among students.

Flipped Classroom

The flipped classroom approach involves providing students with access to online video lectures or tutorials before the in-class sessions. This allows students to engage in interactive and collaborative activities, such as debates, problem-solving activities, and discussions. In the classroom, the teacher acts as a facilitator and observes the students' performance, providing individual or group feedback, as needed. The flipped classroom model enhances students' learning experiences by allowing them to engage with the material at their own pace and encouraging them to take an active role in their learning. Additionally, it allows teachers to use classroom time more efficiently and effectively, as they can focus on providing personalized support and guidance to their students (See Loizou, 2022). The technological tools that can be used in this teaching strategy include video creation and sharing tools. These tools can be used to create and share pre-recorded lectures, tutorials, or other instructional videos that students can watch before the classroom session. The most common video creation tools are Camtasia and Adobe Premiere Rush. With Camtasia[1], the teacher can record the computer screen, webcam, and audio simultaneously, allowing the creation video tutorials and demos that show exactly how to complete a task. In addition to recording and editing videos, Camtasia also offers features for sharing and publishing the generated product. The teacher can export the videos in various formats, including MP4, WMV, AVI, and MOV, and share them on YouTube, or other online platforms. Adobe Premiere Rush[2] allows teachers to create and edit high-quality videos. It also includes features such as trimming and splitting clips, adding text overlays and graphics, and creating customized titles and transitions, as well as adding motion graphics and animations. Moreover, this tool includes integration into popular social media platforms such as YouTube, Instagram, and Facebook, making it easy to export videos in the correct format and aspect ratio. Other technological tools used for flipped classroom include online discussion and collaboration tools, such as Flipgrid[3]. The latter is a video-based social learning platform that allows teachers and students to create and share short video responses to prompts or questions. With Flipgrid, the teacher can create a "Grid", which is a collection of topics for discussion or prompts for students to respond to using video. Students can then create video responses to these prompts and respond to their classmates' videos. Subsequently, the teacher provides feedback and assessments on the student videos. Furthermore, students can record and edit their videos using a range of editing tools, including filters, emojis, and text annotations. Flipgrid integrates with other educational tools such as Microsoft Teams, Google Classroom, and Canvas, making it easy to incorporate into existing workflows.

[1] Camtasia: https://www.techsmith.com/video-editor.html
[2] Adobe Premiere Rush: https://filmora.wondershare.net/alternative-adobe.html
[3] Flipgrid: https://info.flip.com/en-us/blog/product-updates/flipgrid-updates-timeline.html

Inquiry-Based Learning

Inquiry-based learning is an approach that focuses on developing students' problem-solving skills by engaging them in an active and collaborative learning process. In this approach, the teacher plays the role of a facilitator rather than a lecturer. He/she poses questions, situations, and problems that require students to think critically and find solutions. Students are then encouraged to research these topics individually or in groups, using various resources such as books, articles, and websites, to formulate their answers. This research process not only helps students develop their understanding of the topic, but also enables them to practice essential research and information literacy skills. After conducting their research, students present their findings and supporting evidence to the class. This presentation allows them to further develop their answers by listening to what their peers have found, identifying areas that require more attention, and refining their arguments. This also promotes collaboration and teamwork among students, which is essential in today's workforce. Moodle[1], a virtual learning environment, can be used as a tool to support inquiry-based learning strategies. The teacher creates a repository of learning materials such as videos, articles, and case studies that students can access anytime and anywhere. This helps students engage in self-directed learning and explore the topic they are researching. Moodle also provides various tools for collaboration such as discussion forums, wikis, and chat rooms. Moreover, the teacher can create groups and assign group projects, which promotes teamwork and helps students develop important skills such as communication, delegation, and negotiation. This platform also allows teachers to monitor student progress, provide feedback, and assess their learning. The feedback helps students understand their strengths and weaknesses and provides guidance on how to improve their work.

Google Workspace[2] (formerly Google Suite) is another tool that could be used in inquiry-based learning. Students can collaborate, share ideas, and receive feedback in real-time, which enhances their learning experience and improves their critical thinking skills. The tools available in Google Suite can help streamline the inquiry-based learning process and make it more efficient and effective. On the one hand, students can use Google Docs to collaboratively write and edit documents related to their research and inquiry questions. They can also share their documents with their peers and teachers for feedback and suggestions. Students can also use Google Slides to collaboratively create presentations and share their findings and solutions to problems they have investigated. They can also use Google Drive to store and organize their research and inquiry materials, such as articles, videos, and images. On the other hand, teachers can create through Google Forms surveys and quizzes to collect feedback from students on their understanding of a particular topic or to assess their progress in their inquiry-based learning journey. They can also use Google Classroom to create a virtual learning environment where they can share resources, assign tasks, and provide feedback to students. ThingLink[3] is another tool that can be utilized to facilitate engaging and interactive inquiry-based learning

[1] Moodle: https://moodle.org/
[2] Google Workspace: https://workspace.google.com/business/
[3] ThingLink: https://www.thinglink.com/

experiences for students. By using ThingLink, teachers design interactive images, videos, historical events, scientific experiments, and presentations that students can explore and discover on their own, enabling them to gain a deeper understanding of a wide range of topics. Additionally, teachers can leverage ThingLink to create interactive presentations that encourage collaboration among students. They can invite their peers to add their own information, links, and videos to these presentations, thereby facilitating peer-to-peer learning. By designing interactive images and videos that provide different learning styles and abilities, teachers can ensure that all students have access to the same learning opportunities. For example, by providing links to different types of resources such as text, audio, or video, teachers can accommodate different learning styles and abilities. Nearpod[1] can also support inquiry-based learning as teachers can use its interactive features to design engaging presentations and activities that motivate students to investigate, examine and learn about various topics. Before initiating the inquiry process, teachers can utilize Nearpod to evaluate students' preexisting knowledge and comprehension of a given topic. They can also create interactive lessons that allow students to explore and examine a topic, and work collaboratively to share their discoveries and insights with each other. Furthermore, through Nearpod, teachers can provide students with multimedia materials such as images, videos, and audio files to improve their research and inquiry.

Open-Ended Questions

The technique of using open-ended questions promotes lively class discussions and helps improve students' communication skills. By posing open-ended questions, the teacher prompts students to connect various pieces of information they have acquired or encountered in their lives, enabling them to link related ideas. This approach not only encourages students to express their own views but also allows them to find their own voice. Seesaw[2] is a digital portfolio tool that can be effectively utilized for open-ended questioning in the classroom. By using Seesaw, teachers can present open-ended questions to students and encourage them to respond in various formats, including written responses, audio recordings, and videos. Students can use Seesaw to share their work and ideas with their peers, creating an environment that encourages collaboration. Furthermore, Seesaw's feedback and commenting features provide opportunities for ongoing discussions, promoting critical thinking and reflection among students. Additionally, teachers can use Seesaw to offer personalized feedback to students on their open-ended responses, supporting them in further enhancing their communication and critical thinking abilities. Poll Everywhere[3] is another tool that can facilitate open-ended questions effectively. It allows teachers to ask questions and receive instant responses from their students. Using Poll Everywhere, students can respond anonymously, which can encourage them to express their thoughts and ideas more honestly. Teachers can display the responses in real-time, stimulating class discussions and encouraging students to share their

[1] Nearpod: https://nearpod.com/
[2] Seesaw: https://web.seesaw.me/
[3] Poll Everywhere: https://www.polleverywhere.com/

opinions. Furthermore, Poll Everywhere enables students to respond with multimedia such as images and videos, providing a platform for creative thinking and self-expression.

Peer and Self-Feedback

Developing the ability to offer and accept constructive feedback is an important aspect of students' learning. Peer feedback plays a crucial role in enabling students to evaluate and assess each other's work, helping them gain insights into the quality of their own work and develop evaluative judgement and self-regulated learning skills (Nicol, 2010). Digital tools such as Canvas Pages, Google Docs, and Peergrade can facilitate peer feedback. Canvas Pages[1] can be utilized for peer feedback in several ways. The teacher can assign group assessments and create a separate Canvas Page for each group to collaborate on. By utilizing the commenting feature, each group can offer feedback on each other's work uploaded on the Canvas Page. Moreover, students can create their ePortfolios on Canvas Pages to share their work and receive constructive feedback from their peers. Canvas Pages allow for multimedia elements like videos, images, and links, which provide students with a variety of options to enhance their feedback. Additionally, Canvas Pages maintains a revision history, enabling students to keep track of their progress over time and make revisions based on the feedback received. Google Docs[2] is a collaborative writing tool that can facilitate peer feedback within a classroom setting. By assigning group writing projects, teachers can encourage students to share feedback and work together in creating a shared document using Google Docs. For peer editing purposes, teachers can pair up students and encourage them to use the commenting and suggesting features in Google Docs to provide feedback and make necessary changes to their peer's writing. Students can also create writing portfolios using Google Docs, which allows them to display their work and receive feedback from their peers. With Google Docs, students can track the revision history of their work, which gives them an opportunity to analyze their progress and make improvements to their writing skills accordingly. Peergrade[3] is an online platform that focuses on peer feedback and evaluation. With Peergrade, teachers can create assignments and rubrics that are distributed to students, who can then submit their work through the platform for peer review. Peergrade ensures that each student receives multiple reviews from his/her peers by assigning grades based on the teacher's rubrics. Anonymous feedback is available in Peergrade, encouraging students to be more honest and constructive. Peergrade reports allow teachers to identify areas for improvement as they monitor the feedback process and view the comments and grades assigned by students.

In addition to peer feedback, self-feedback is also valuable for students as it helps them in their self-regulation and critical self-reflection, which are essential for achieving success (Ryan, 2020). By engaging in self-feedback, students can identify their strengths and weaknesses, set goals, and make necessary improvements to their work. Self-feedback helps students become more self-aware, reflective, and proactive in their learning process. Teachers can facilitate this

[1] Canvas Pages: https://www.canva.com/
[2] Google Docs: https://www.google.com/docs/about/
[3] Peergrade: https://www.peergrade.io/

process by providing students with clear and specific criteria or rubrics to evaluate their work, using rubrics to provide students with a framework for self-assessment and help them understand the expectations for their work. Using digital tools such as ePortfolios, students can create a personalized space to upload their work, provide self-assessment and reflection, and receive feedback from their teachers and peers. Platforms for creating ePortfolios include Google Sites[1], Weebly[2], and WordPress[3]. Through self-feedback, students gain a deeper understanding of their own learning process, develop self-regulatory skills, and become proactive learners.

Peer Learning

According to Havnes et al. (2016), peer learning can offer several advantages to students, such as enhancing time management, communication, and study skills, encouraging creative and critical thinking, promoting psychological well-being, increasing academic aspirations and expectations, and fostering lifelong learning. To implement this teaching strategy, the teacher can group students and provide them with different pieces of information related to the subject. Each group learns and comprehends the information to explain it to other groups. The process is repeated until every group has a complete understanding of the subject matter. Alternatively, students can select an area of interest within the subject matter and conduct independent research on it. They can then create a PowerPoint presentation to present to the class, which can encourage information sharing and group discussion. Quizlet[4] is an effective digital tool that enhances the learning experience through peer collaboration. This online platform allows students to create digital flashcards, which can be used to test their knowledge and shared with their peers, enabling them to actively participate in the learning process and reinforce their understanding. In addition to flashcards, Quizlet provides several other features that support peer learning. For example, it offers various study modes such as games, quizzes, and audio materials that are aligned with different learning styles, allowing students to engage with the material in diverse ways. This aspect promotes mutual learning and allows students to benefit from the diverse insights and perspectives of their peers.

Project-based learning (PBL)

Project-based learning (PBL) is an instructional approach that offers students a hands-on, real-world learning experience. The teacher proposes a project, and students work together to analyze, research, and develop an action plan to address the given problem. PBL encourages students to engage with the subject matter actively and apply what they have learned to their project. This learning strategy fosters the development of critical thinking, problem-solving, and decision-making skills. The teacher takes on the role of a guide and mentor, supporting students throughout the learning experience. Through PBL, students become more self-directed in their learning, taking ownership of their project, and making decisions about their

[1] Google Sites: https://workspace.google.com/intl/en/lp/sites/
[2] Weebly: https://www.weebly.com/
[3] WordPress: https://wordpress.com/
[4] Quizlet: https://quizlet.com/

work. This approach also promotes the development of social and emotional skills, such as collaboration and effective communication. Glogster[1] is a tool that could be used in this learning strategy. Students can create glogs to showcase research findings or create visual portfolios of their work, using various media types and external hyperlinks. Collaborative projects are also possible, with students working together to create glogs that represent different aspects of a larger topic. Another tool that could be used in PBL is Edorble[2]. With this platform, students can create their 3D virtual classrooms and interact with various digital resources. For example, in a science class, students can generate their virtual worlds based on a particular topic such as designing a virtual ecosystem that highlights the interdependence of different species. They can populate the ecosystem with various species and create interactive elements that provide more information about their relationships, helping them develop a deeper understanding of the subject matter.

Although technology tools have revolutionized teaching and learning methods, just providing teachers with these tools is insufficient. For technology to have a significant influence on education, it is necessary to train teachers to use them properly. The absence of proper training could lead to difficulties in integrating technology into teaching, which may negatively impact the learning and engagement of students. Hence, it is imperative for educational institutions and schools to emphasize teacher training programs that provide the essential skills and knowledge to use technology tools effectively in the classroom. That being said, it is important to emphasize the crucial role of teachers in technology-based education.

Importance of Teacher's Role in Technology-Based Education

The advancement in education and the enhancement of teaching and learning techniques can greatly contribute to the improvement of students' academic performance, especially in the K-12 setting. However, the evolution of education also presents challenges for K-12 teachers regarding the implementation of new teaching theories and methods. As education continues to evolve, teachers are expected to take on new roles as leaders and facilitators for students, moving away from traditional teaching techniques to become more actively involved in their students' learning process. By adopting this approach in the K-12 setting, teachers will be better equipped to identify their students' interests, encourage their enthusiasm for learning, and develop their critical thinking skills and intellectual curiosity (Kelly and McAnear, 2002). In other words, the transformation in education offers an opportunity for teachers to shift from the traditional role of being just transmitters of knowledge to becoming facilitators of learning. This means that they will not only deliver knowledge but also provide students with a conducive environment to learn actively and independently. Therefore, teachers will better understand their students' individual needs and interests, making learning more engaging and relevant to their lives.

[1] Glogster: https://edu.glogster.com/
[2] Edorble: https://www.edorble.com/

Although technology has transformed the teaching and learning process, it cannot replace the teacher. In a technology-based and student-centered learning environment, teachers are more than just instructors: they are instructional designers, trainers, and mentors. As instructional designers, teachers plan and organize their classrooms to effectively integrate technology into their curriculum and create well-designed activities to meet the individual needs of their students. They also act as trainers, showing students how to use software tools to accomplish learning tasks. Additionally, they act as team coordinators, creating opportunities for collaborative and social learning activities, peer tutoring, and support among students with varying abilities. As enabling mentors, they offer advice and ask questions to help students find the information they need to complete tasks. They work with students to create a learning environment that is engaging and challenging, using technology to enhance learning and providing support and guidance throughout the process. They create a safe and supportive environment that encourages students to take risks and learn from their mistakes. Through their multiple roles, teachers enable students to become active and independent learners, capable of applying the knowledge and skills they acquire to real-world situations. Eventually, technology is a tool that teachers can use to enhance the learning process, but it is the teacher who plays a crucial role in guiding and supporting students' growth and success.

Therefore, while incorporating educational technology to enhance student learning, teachers must shift their perspectives on teaching and learning and be open to new responsibilities. To effectively address technology challenges and facilitate teaching and learning, they must be willing to learn new skills (Zhu et al., 2010). One such skill is developing computer proficiency to maximize the benefits of interactive and engaging technologies in education and create positive interactions with their students. Nevertheless, for teachers to become proficient and effective users of technology, they require tailored resources, updated training programs, ongoing support, and flexibility (Roschelle et al., 2005). This is essential if they are expected to perform their duties as learning facilitators, especially when integrating technology in the K-12 classroom setting. The purpose of education is to empower rather than to provide knowledge, as Nuyen (1995) succinctly explains. There is now a need to find educators who can both provide knowledge and spark students' creativity, so teachers are required to have a deep understanding of how each student learns and the abilities to adapt the learning systems (Volman, 2005). Educational technologies are practical tools that facilitate teachers' tasks. Nevertheless, rather than being easier, the instructors' responsibility will get more challenging as they need to design various pedagogical approaches, gather educational materials, and organize them in a systematic methodology.

Furthermore, developing TPCK requires continuous professional development, a growth mindset, and various strategies, including attending technology integration workshops, engaging in collaborative learning communities, practicing reflection, and designing technology-integrated lesson plans. By aligning their teaching practices with TPCK principals in the K-12 setting, teachers can leverage technology effectively and create dynamic learning environments that foster active student engagement and meaningful learning experiences. Continuous re-evaluation of teacher education practices is needed to propose new strategies that effectively facilitate technology integration in the classroom.

Conclusion

Technology-based education enables K-12 students to access, analyse, manage, synthesize, evaluate, create, and share information in a variety of forms and media that incorporate a global perspective (McNeil, 2015). This integration of technology and its various applications aligns with the concept of TPCK, which underscores the importance of educators possessing a deep understanding of how technology, pedagogy, and content intersect. It also reinforces a student-centred learning environment that contributes to enhance the students' competencies in creativity, communication, collaboration, digital literacy, critical thinking, and problem solving, all of which are central components of TPCK. Therefore, schools are responsible not only for integrating technology into the curriculum but also for doing so in a way that synergizes pedagogical approaches with technology tools while considering the principles of TPCK.

Advancing technology-based education and integrating technology tools into the teaching and learning process is crucial in achieving this goal of comprehensive student development. This integration, when approached with an awareness of TPCK, empowers educators to design learning experiences that holistically nurture students' abilities. By investing in these areas, schools not only enhance student learning outcomes but also equip educators with the necessary skills and resources to effectively engage students and foster their growth as autonomous lifelong learners. Ultimately, investing in technology-based education becomes an investment in the future success of students, preparing them not only for their future careers but also for the challenges and opportunities they will encounter in higher education and university settings.

Furthermore, additional research studies are needed to address two key areas in education. The first area is designing innovative teaching strategies to address the challenges that students face in a rapidly changing world. Teachers need to adopt creative approaches to instruction to prepare students for their future careers. The second area is the integration of technology into the curriculum to promote student-centred learning and develop critical thinking, problem-solving, and creativity. By conducting further research in these areas, educators can better prepare students for the future, create effective strategies for technology integration, and lifelong learning. In addition, as new technologies, such as the ChatGPT and all OpenAI tools, become increasingly accessible to everyone, it is important to conduct further research to assist educators in integrating Artificial Intelligence into the teaching and learning process.

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ISSN: 2187-0594