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Exploring the Integration of ChatGPT in Inquiry-based Learning: Teacher Perspectives

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Abstract

ChatGPT, an AI-powered service known for its effective delivery of information and solutions, has the potential to transform education, scientific problem-solving, and student learning. However, to fully harness its advantages, understanding the pedagogical approach needed is essential. This study explores teachers' awareness of ChatGPT and the inquiry-based learning (IBL) 5E model, examines ChatGPT's effective use within IBL, and investigates teachers' perceptions and experiences when integrating ChatGPT into the IBL framework. Employing an exploratory qualitative approach, this research gains insight into teachers' perspectives on ChatGPT's integration into IBL. The study involves two distinct focus groups comprising Junior Secondary School (JSS) and Senior Secondary School (SSS) science teachers in Nigeria. The findings highlight that while some teachers have actively integrated ChatGPT into the IBL 5E model and are already experiencing its benefits, others are at varying stages of awareness and adoption. The interest and curiosity expressed by some teachers suggest a potential for broader adoption as educators become more familiar with ChatGPT's capabilities within the context of IBL. This aligns with the idea that technology integration often involves a phased approach, with early adopters paving the way for broader usage.

Introduction

Inquiry-based learning (IBL) is a pedagogical approach in which students are at the core of teaching-learning activities. The IBL approach fosters critical thinking, active exploration, questioning, hands-on experiences, and problem-solving (Gholam, 2019). It is based on the concept that students are better poised to grasp and retain information when they are actively involved in the learning process, rather than being passively exposed to information for rote memorization. Coffman (2017) opines that inquiry-based learning emphasizes the learner's active role in shaping their own comprehension and knowledge. This process involves asking questions, acquiring, and assessing information, and constructing their knowledge. The IBL is widely recognized as a highly effective learning approach (Hu et al., 2017). Conversely, in inquiry-based learning, the teacher's role shifts to that of a facilitator, aiding students in constructing their knowledge and steering them through the process of inquiry. Another distinguishing feature is the emphasis on problem-solving and critical thinking. Instead of mere rote memorization and adherence to predefined procedures, inquiry-based learning promotes critical thinking and problem-solving by encouraging students to apply their own ideas and methods. In contrast, traditional teacher-

centered instruction often places more importance on memorization and strict adherence to predetermined processes (Kulapian et al., 2023). The constructivist theory underpins the IBL approach. This theory posits that learning is an active process where students construct new ideas and concepts by building upon their prior knowledge and experiences (Desouza, 2017; Nazziwa et al., 2022). Despite the existence of several models designed to steer scientific inquiry, the 5E model is recognized as a highly influential instructional model in science education (Bybee, 2009).

The integration of Artificial Intelligence (AI) into education has been a transformative development, revolutionizing the way students learn and teachers instruct. AI technologies are increasingly playing a pivotal role in personalized learning, data-driven decision-making, and the overall improvement of educational outcomes (Ahmad et al., 2020; Tapalova & Zhiyenbayeva, 2022). AI possesses the capability to execute tasks typically associated with intelligent beings, including learning and decision-making (Joiner, 2018). AI has demonstrated its effectiveness in tackling intricate challenges across various domains, including education (Tuomi, 2018). The application of AI in the realm of natural language processing has given rise to intelligent chatbots and virtual assistants proficient in both comprehending and generating human language (Caldarini et al., 2022).

Recent advancements in AI, machine learning (ML), and natural language processing (NLP) have culminated in the emergence of large language models (LLM) like ChatGPT, an AI-driven chatbot developed utilizing Generative Pre-trained Transformer technology (Karakose, 2023). ChatGPT exhibits the ability to respond to a diverse range of conversational prompts in a manner that mimics natural human interactions. It can provide answers to follow-up questions, acknowledge errors, and reject inappropriate requests. This leading chatbot has rapidly demonstrated exceptional performance across an array of tasks, including answering open-ended and analytical questions spanning subjects such as physics, mathematics, business and law (Choi et al., 2023; Terwiesch, 2023; Wardat et al., 2023; West, 2023). Furthermore, it has been instrumental in assisting healthcare professionals in diagnosing diseases (O'Connor & ChatGPT, 2023) facilitating code generation in various programming languages, thereby enhancing the code-writing process (Godoy et al., 2023; Noever & McKee, 2023).

ChatGPT has gained prominence as an innovative AI service that caters to humanity's quest for information, delivering answers and proffering solutions online with remarkable performance (Macdonald et al., 2023). It has extensive potential to revolutionize education, develop instructional model contents, address scientific problems, and enhance student learning. It presents the opportunity for teachers to create customized and appropriate educational content, fostering increased student engagement, motivation, and academic attainment (Guo et al., 2023). Furthermore, ChatGPT serves as a valuable tool for educational assessments and evaluations, offering educators the means to swiftly evaluate student assignments and provide constructive feedback, as evidenced by research conducted by Javaid et al. (2023) and Kostka and Toncelli (2023).

In science education, ChatGPT can support learning by facilitating prompt responses to student questions, thereby facilitating the development of scientific concepts. Leveraging state-of-the-art innovation, users can inquire about scientific concepts using natural language and receive immediate, comprehensible responses. ChatGPT empowers

the creation of instructional models for science subjects and facilitates their dissemination in the classroom. While ChatGPT holds the potential to augment education and student learning, it is imperative to view it as a complementary tool together with human teachers (Wardat et al., 2023). Teachers can harness ChatGPT to generate personalized content, evaluate student progress, and provide feedback. Nonetheless, it is crucial to recognize and employ its limitations ethically and responsibly (Dwivedi et al., 2023; Javaid et al., 2023; Rudolph et al., 2023).

While ChatGPT presents significant potential in education, there is a critical need to investigate the pedagogical approach necessary to fully harness its advantages. The objectives of this article include, investigating the teachers' awareness of ChatGPT and IBL 5E model, examine the effective utilization of ChatGPT in the context of IBL and investigate teachers' perceptions and experiences regarding the integration of ChatGPT with the IBL framework. Based on the objectives, four research questions were raised: (1) how does teachers' awareness of ChatGPT influence their incorporation of this technology into their teaching practices? (2) what is the extent to which teachers are familiar with the IBL approach and the 5E Model, and how does their familiarity or lack thereof impact the integration of these pedagogical frameworks into their teaching practices? (3) what is the extent of teacher integration of ChatGPT into the IBL 5E model, and what specific instructional purposes do they primarily use it for in science education? and (4) how do teachers perceive the impact of integrating ChatGPT in IBL on student engagement, learning outcomes, and teacher support?

Literature Review

The IBL 5E Instructional Model

The 5E model forms a learning cycle that was reframed by (Bybee et al., 2006) in reference to an earlier Learning Cycle model (Atkin & Karplus, 1962). The original model consisted of the exploration, explanation, and extension phases, constituting a 3E learning cycle. Marek (2008) claims that 3E learning cycle was influenced by Piaget's model of mental functioning. The 5E instructional model is rooted in cognitive psychology, constructivist learning theory, and best practices in science teaching (Desouza, 2017). It facilitates the creation of science lessons by following a cyclical process encompassing five cognitive learning phases: engagement, exploration, explanation, elaboration, and evaluation.

In the initial engagement stage, the teacher evaluates the students' existing knowledge and identifies knowledge gaps. A key aspect of this phase is to generate the students' curiosity about the concepts. This stage may involve encouraging students to pose initial questions or write down their existing knowledge. It is during this stage that students begin to grasp the core concept. The exploration phase revolves around students gaining knowledge through concrete, hands-on experiences. They might follow the scientific method and make observations alongside their peers. In the subsequent explaining phase, the teacher transitions into the role of a facilitator. Their primary task is to assist students in synthesizing their newfound knowledge and encourage them to ask questions. Teachers typically encourage students to share what they have learned to make this phase effective before introducing more technical information. Teachers employ teaching aids like videos, computer software, and supplementary materials to facilitate comprehension. The elaboration phase allows students to apply what they

have learned, thereby enhancing their understanding. Teachers may assign tasks like presentations or research projects through group or class discussions regarding individual learning outcomes to reinforce newly acquired skills. This phase solidifies the students' comprehension before they move on to evaluation. In the final stage of evaluation, the 5E model incorporates formal and informal assessment methods. During this phase, teachers employ various evaluation tools, including self-assessment, peer assessment, written assignments, and examinations, to gauge the learners' grasp of the core concepts (Yonyubon et al., 2022).

The 5E instructional model is also entrenched in the constructivist learning approach, which is based on the premise that learners already possess their own conceptions of the world, and they construct knowledge by comparing new ideas with their existing understanding of reality. When new concepts align with their existing knowledge, they readily integrate them, but when faced with unfamiliar ideas about how the world functions, learners engage in the process of adaptation (Colburn, 2003). Also, Tamim and Grant (2013) indicated that constructivist learning approach, as seen in IBL, underscores the learner's active role in constructing their own understanding and knowledge through research and study. Additionally, the research-based 5E model also embraces the idea that learning occurs within a social context, emphasizing the importance of cooperation, collaboration, and the joint construction of ideas as integral aspects of the learning process.

In essence, IBL is an approach that cultivates a diverse array of critical skills and qualities in learners. It serves as an educational landscape where essential attributes such as critical thinking, creativity, curiosity, active exploration, questioning, hands-on experiences, and problem-solving are not only encouraged but thrive. Judicious use of ChatGPT within the IBL framework will transform traditional classrooms into hubs of innovation, where technology becomes an ally in the quest for knowledge. However, the realization of this transformation hinges on teachers' critical intentionality, their capacity to use ChatGPT effectively and ethically, and their diligence in preserving the essence of IBL as a holistic approach that nurtures inquisitive minds, critical thinkers, and creative problem solvers. As such, ChatGPT becomes a tool that, when carefully integrated, can elevate the educational experience, fostering a new era of innovative teaching and learning.

Emergence of AI in Education

AI has gained significant prominence among emerging technologies, experiencing rapid advancements and widespread adoption in various sectors, including education, in recent years. AI has become an integral facet of human existence and plays a pivotal role in numerous aspects of contemporary life. The twenty-first century has transformed AI from a concept into a practical necessity, convincingly demonstrating its indispensability (Alam et al., 2022). These technologies possess the capability to generate outputs akin to those produced by humans, substantially conserving human time and effort (Aljanabi, 2023; Mijwil et al., 2023; O'Connor & ChatGPT, 2023). The overarching concept of AI encompasses an array of technologies and methodologies associated with the ability of computer systems to execute tasks that typically demand human intelligence (Livberber & Ayvaz, 2023). . In essence, AI constitutes the emulation of human intelligence in machines, which are programmed to think and behave in a manner akin to humans. Among the subdomains within AI, notable areas of focus encompass machine learning, supervised learning, unsupervised learning, natural language generation, and natural language

processing (NLP) (Livberber & Ayvaz, 2023; Noain-Sánchez, 2022). One specific category of chatbots, leveraging AI, is the AI chatbot. These AI chatbots are engineered to engage users in natural, human-like conversations, comprehending their inputs and responding contextually, all thanks to their NLP capabilities. Their primary function is to interact with humans effectively, understanding and responding to users' language and intentions (Dwivedi et al., 2023; O'Connor & ChatGPT, 2023). A potent AI-driven chatbot in existence is ChatGPT.

Integration of ChatGPT in Education

Existing Research on ChatGPT in Educational Contexts

ChatGPT, a powerful AI tool, made its debut in November 2022 introduced by OpenAI. Its rapid ascent is evident as it attracted the interest of over a million users within a week and garnered substantial media attention. Functioning akin to a chatbot, ChatGPT generates textual responses based on user-provided prompts, encompassing both straightforward text outputs and intricate outputs such as programming code, sonnets, complete essays, and mathematical theorems (Ellis & Slade, 2023; Roose, 2022). Its utility extends to a diverse array of natural language processing tasks, encompassing language translation, text summarization, question answering, and chatbot functionalities. Its standout feature lies in its ability to comprehend and engage with human inputs in a conversational manner, rendering it ideally suited for interactive applications (Fütterer et al., 2023). In the realm of education, ChatGPT has the potential to significantly impact teaching and learning practices. This may include, for example, the ability to provide more individualized instruction, adaptive learning, tutoring and homework help, language learning, educational content creation, searching and retrieving information such as literature reviews, research writing and fact-checking, and lifelong learning by giving students of all ages access to a vast library of information and resources (Baidoo-Anu & Owusu Ansah, 2023; Farrokhnia et al., 2023; Zhang, 2023), and more effectively coordinate the processes of grading, assessment, and evaluation (Baidoo-Anu & Owusu Ansah, 2023; Ellis & Slade, 2023; Kasneci et al., 2023; Rudolph et al., 2023). In addition, Kasneci et al. (2023) emphasize the potential to compensate for educational disadvantages. ChatGPT can help students with disabilities by providing text-to-speech and text-to-speech functions or automatically generating written texts. For visual impairments or partial disabilities such as dyslexia, learning can be less restrictive, contributing to an inclusive and accessible education.

Integrating ChatGPT into the Inquiry-based Learning 5E Model

Integrating ChatGPT into the inquiry-based learning 5E model can yield numerous benefits for teachers. This innovative integration introduces a powerful ally in the quest for effective education. Firstly, ChatGPT aids teachers in crafting engaging and knowledge-rich lessons. In the "engagement" phase, it can be a valuable tool for crafting questions that stimulate student engagement and help assess their prior knowledge. Also, it can help identify gaps, enabling teachers to tailor their instructional plans to individual needs. During the "exploratory" phase, when students actively investigate and experiment, ChatGPT becomes a handy assistant. It provides instant responses to queries, offers guidance, and suggests additional resources, which eases the workload for teachers (Novak, 2023; Watson, 2023).

In the "explanation" phase, ChatGPT can offer alternative explanations or supplementary materials, ensuring that complex concepts are comprehensible to all students. This enhances inclusivity and accessibility in the classroom (Kasneci et al., 2023). During the "elaboration" phase, ChatGPT can assist teachers in expanding and deepening the foundational knowledge gained in the earlier stages. This stage involves refining concepts, further exploring, and applying learning in more complex and varied contexts. For teachers, assessment during the "evaluation" phase can be streamlined with ChatGPT. It can generate assessment materials, such as quizzes or assignments, aligning them with the learning objectives (Atlas, 2023; Northwest Executive Education, 2023). This not only saves time but also ensures that assessments are meaningful. Moreover, ChatGPT contributes to the enrichment of classroom dialogues by introducing a variety of perspectives and viewpoints. It actively promotes critical thinking among students, encouraging them to approach problems from multiple angles, which aligns perfectly with the principles of inquiry-based learning.

Theoretical Framework

The research is grounded in Rogers' Diffusion of Innovations (DoI) theory, aiming to comprehend the intricate process of adopting emerging technologies in educational contexts (Rogers, 1983). The study explores teachers' perspectives of integrating ChatGPT into inquiry-based learning approach. The theory classifies adopters into distinct categories. The adopter categories are described as "classifications of members within a social system based on their innovativeness" (Rogers, 2003, p. 22). These categories encompass innovators, early adopters, early majority, late majority, and laggards. Each category shares common innovation traits, where an individual's innovativeness is assessed by the timing of their adoption of new ideas relative to other members of the system (Sahin, 2006).

First are the Innovators, known for their adventurous spirit and willingness to experiment, enthusiastically embracing new ideas. In the context of ChatGPT integration, these individuals are the pioneering teachers who boldly explore ChatGPT in their teaching methods. Following them are the Early Adopters, esteemed opinion leaders within their social system. These leaders play a crucial role in mobilizing resources, guiding innovation from initiation to implementation (Light, 1998). They are pivotal in influencing their peers, advocating for, and successfully integrating ChatGPT into teaching practices.

Moving on to the Early Majority, this group is characterized by pragmatism, adopting innovations after thorough observation. The early majority embraces innovation before the latter part of the process, positioning themselves as early adopters. The Late Majority adopts innovations when they become commonplace or necessary, and delving into their concerns and motivations reveals potential barriers and strategies for broader acceptance. Finally, the Laggards resist change due to fear of technology or a preference for traditional methods. Understanding why some teachers resist integrating ChatGPT unveils deep-seated concerns that impact comprehensive adoption (Minishi-Majanja & Kiplang'at, 2013).

Relevant to this study, the DoI theory offers a structured framework for understanding the stages of adoption among teachers regarding ChatGPT in IBL. Widely applied in educational technology research, particularly by

Rogers (2003), this theory remains pertinent in understanding the dynamics of technology adoption in educational contexts. Through this theoretical lens, we aim to unravel the complexities of ChatGPT integration, providing nuanced insights into the adoption patterns and challenges faced by teachers in embracing this innovative technology in their pedagogical practices.

Methodology

Research Design

This research adopts an exploratory qualitative approach to gain a comprehensive understanding of teachers' perspectives on integrating ChatGPT into Inquiry-Based Learning (IBL). The qualitative method allows for an in-depth exploration of the nuances and complexities of this integration from the teachers' viewpoint (Creswell & Creswell, 2017).

Research Context

This study was conducted among science teachers within the private school sector in urban areas of Nigeria. The participants in this study were drawn from city schools, predominantly serving students from middle-class socioeconomic backgrounds.

Participants

The study involves two distinct focus groups comprising Junior Secondary School (JSS) and Senior Secondary School (SSS) science teachers. The study comprises a total of fifteen science teachers, with seven from Junior Secondary Schools (JSS) and eight from Senior Secondary Schools (SSS). These participants were purposefully selected due to their pivotal role in shaping science education at these critical educational levels.

Data and Analyses

Data was collected through semi-structured interviews and focus group discussions. Semi-structured interviews were conducted individually with select teachers to delve deeply into their experiences and perceptions. Focus group discussions provide a platform for teachers to share and reflect on their collective experiences and opinions regarding ChatGPT in IBL. A carefully crafted interview guide was used during semi-structured interviews and focus group discussions. The interview session per group took about 1-hour 45minutes. This guide contains open-ended questions that encourage teachers to express their thoughts, experiences, and insights regarding ChatGPT's integration.

The audio recordings of the focus group sessions were transcribed. Thematic analysis was employed to identify recurring themes and patterns in the qualitative data. This process involves systematically identifying, organizing, and interpreting patterns and themes within the teachers' responses. It enables the extraction of valuable insights from the rich dataset.

Results

Demographic Variables

Table 1 displays the demographic characteristics of the study participants. The table indicates that there were seven female participants, accounting for 47% of the total, and eight male participants, constituting 53%. In terms of teaching experience, four participants had between 1 and 5 years of experience, another four had 6 to 10 years, five had 11 to 15 years, and two had 16 years or more. Among the participants, seven were Junior Secondary School science teachers, while eight were Senior Secondary School science teachers.

Table 1. Demographic Variables of Participants

Participants	Gender	Years of Teaching experience	Class
Teacher 1	Female	3	SSS
Teacher 2	Female	1	SSS
Teacher 3	Male	12	SSS
Teacher 4	Male	10	JSS
Teacher 5	Male	7	SSS
Teacher 6	Male	5	JSS
Teacher 7	Female	15	JSS
Teacher 8	Male	4	JSS
Teacher 9	Female	6	JSS
Teacher 10	Female	10	SSS
Teacher 11	Male	15	JSS
Teacher 12	Male	17	SSS
Teacher 13	Female	15	JSS
Teacher 14	Male	18	SSS
Teacher 15	Female	11	SSS

Research question 1: How does teachers' awareness of ChatGPT influence their incorporation of this technology into their teaching practices?

Assertion 1: The findings derived from the interviews conducted within Focus Group 1, it is evident that three teachers have acquired an awareness of ChatGPT and have recognized its potential applications in the realm of education. Out of these three, two teachers possess a partial understanding of ChatGPT and have recently incorporated it into their teaching methodologies. Conversely, the other two teachers within this group have merely heard about ChatGPT but lack a comprehensive knowledge of its functionality, consequently refraining from integrating it into their teaching practices.

On the other hand, the feedback gathered from Focus Group 2 participants reveals two teachers are highly familiar with ChatGPT. One of them has utilized it for personal research, while the other has applied it in an educational context. Among the remaining five teachers, they are generally familiar with ChatGPT, and only one teacher is

unaware of ChatGPT and its usage. This is evidenced in the following excerpts:

Focus Group 1

> Teacher A *"I am familiar with ChatGPT. I heard about it and got a partial introduction during a professional development program. I'm aware of how ChatGPT works and its potential applications in education, and I've personally used it in my teaching practice."*
>
> Teacher B *"I do have some familiarity with ChatGPT. I learned about it during an in-service teacher training session at our school. Thanks to the recent training, I now understand how ChatGPT works and its potential applications in education. I have just started introducing ChatGPT into my teaching practice."*
>
> Teacher C *"I heard about ChatGPT, mainly through colleagues and friends. However, I have not had the opportunity to learn about it in any professional development sessions or conferences. To be honest, I do not have much knowledge about ChatGPT, and I have not used it in my teaching practice."*

Focus Group 2

> Teacher A *"I am highly familiar with ChatGPT, and I was introduced to it in a professional development session. I understand how ChatGPT works, and I have used it for personal research, though I have not incorporated it into my teaching yet."*
>
> Teacher B *"I am familiar with ChatGPT, and I have used it to solve mathematical problems and multiple-choice questions."*
>
> Teacher C *"I am less familiar with ChatGPT. I have only encountered it through social media discussions, and I have not used ChatGPT in my teaching."*

Research question 2: What are the extent to which teachers are familiar with the IBL approach and the 5E Model, and how does their familiarity or lack thereof impact the integration of these pedagogical frameworks into their teaching practices?

Assertion 2: In Focus Group 1, it is observed that five participants possess a fundamental grasp of the IBL approach and the 5E model. Among these five, three have successfully integrated the IBL approach into their daily teaching and learning routines, while two have applied it on a less frequent basis. Nevertheless, one participant expresses uncertainty about their familiarity with the approach, and another participant lacks knowledge of it entirely. Moreover, in Focus Group 2, two teachers exhibit a profound understanding of both the IBL approach and the 5E model, actively incorporating these approaches into their teaching methodologies. Additionally, four teachers possess some familiarity with the approach. Intriguingly, one respondent, initially unfamiliar with IBL and the 5E model, recently underwent training on these methods. It is noteworthy that this teacher had been unknowingly employing a similar approach that aligns with the IBL model. Evidence of this assertion is below:

Focus group 1

> Teacher A *"I am familiar with the Inquiry-Based Learning (IBL) approach and the 5E Model, and I have*

implemented IBL in my teaching practice before."

Teacher B *" I am not sure I am familiar with the Inquiry-Based Learning (IBL) approach and the 5E Model."*

Teacher C *"I am very familiar with the Inquiry-Based Learning (IBL) approach and the 5E Model, and I incorporate them into daily teaching and learning activities."*

Focus group 2

Teacher A *"I am not familiar with the IBL approach and the 5E Model, but I recently received training on it. Interestingly, I had been using a similar method without realizing it was under the IBL approach."*

Teacher B " *Yes, I am very familiar with the IBL approach and the 5E Model, and I actively integrate the approach into my teaching."*

Teacher C *"I am somewhat familiar with the IBL approach and the 5E Model."*

Research question 3: How do teachers perceive the impact of integrating ChatGPT into IBL and 5E model?

Assertion 3: Based on the responses in Focus Group 1, five teachers are aware of ChatGPT. Out of these, two have actively utilized it to developing IBL 5E model lesson plans, notes, generate questions, and support learning activities. The remaining three teachers in this group have not integrated ChatGPT into the IBL5E model. Among the participants in Focus Group 1, two teachers have not yet employed ChatGPT with the IBL 5E model. However, one of them is interested in trying it out, while the other is keen to learn more about its potential applications. Moving on to Focus Group 2, two teachers have successfully integrated ChatGPT into the IBL 5E model. They have employed it for tasks such as defining terms, developing lesson notes, and creating assessment questions. Within this group, four teachers are somewhat familiar with the IBL 5E model, but two of them have not incorporated ChatGPT into their teaching methods, meanwhile, the remaining two have recently integrated ChatGPT into the IBL 5E model. However, there are still two teachers in Focus Group 2 who have not yet used ChatGPT with the IBL 5E model. This is evidenced in the following excerpts:

Focus group 1

Teacher A: *"Currently, I use ChatGPT within the IBL 5E Model for lesson planning, question generation, and fostering creative thinking among students."*

Teacher B: *"I have not used ChatGPT with IBL 5E model, but I will try to use it to develop my lesson notes and see how it can support me and my learners in IBL activities."*

Teacher C: *"I do not know about ChatGPT and IBL 5E model, I would like to learn more about it and how it can enhance my teaching practice"*

Focus group 2

Teacher A: *"I have recently integrated ChatGPT into my IBL 5E lessons, mainly using it for lesson plan and content development.*

Teacher B: *"I have also integrated ChatGPT into my IBL 5E lessons and utilize it for defining terms and developing lesson notes."*

Teacher C: *"I will plan to explore how ChatGPT can be used in the future, but I have not yet used it for my IBL lessons."*

Research question 4: How do teachers perceive the impact of integrating ChatGPT in Inquiry-Based Learning (IBL) on student engagement, learning outcomes, and teacher support?

Assertion 4: In Focus Group 1, two participants who integrated ChatGPT and the IBL 5E model shared their experiences, highlighting the remarkable improvements in their lesson planning and delivery. They emphasized that this integration significantly enhanced student engagement, motivation, and the teacher's ability to support the learning journey. One of the participants anticipated that ChatGPT and IBL 5E might bring changes in teacher-student interactions, although he had not yet incorporated it into their classroom. However, expressed hope that it would address some of the students' concerns. However, in Focus Group 2, two participants discussed how ChatGPT has the potential to support teachers by assisting in the facilitation of personalized support for individual students and simplifying lesson content. They also acknowledged the positive contribution of ChatGPT and the IBL 5E model in generating thought-provoking questions that encourage student thinking and active participation throughout lessons. However, two other participants in Focus Group 2 had recently integrated ChatGPT and IBL into their lessons but could not provide specific information about its contributions to teacher support and student engagement. One participant mentioned not to have witnessed ChatGPT's impact on personalized support for individual students or used it to address student inquiries, doubts, or misconceptions. Nevertheless, believed that if ChatGPT proves helpful in developing lesson notes that stimulate critical thinking and support the creation of engaging activities, it has the potential to enhance student engagement and motivation.

Focus group 1

> Teacher A: *" The integration of ChatGPT into the IBL 5E Model significantly improved my teaching. It enhanced student engagement, motivation, and my ability to support their learning journey."*
>
> Teacher B: *"Integrating ChatGPT improved my teaching by enhancing lesson planning, delivery, and student engagement. It also positively influenced how I support students in their learning process, enhancing their response and understanding of lessons."*
>
> Teacher C: *"I anticipate that ChatGPT may bring changes to teacher-student interactions, even though I haven't incorporated it into my classroom. As I have not used it, I cannot definitively determine whether it will enhance or hinder personalized support to individual students. However, I hope it will address some of the students' concerns if they ask."*

Focus group 2

> Teacher A: *"ChatGPT has the potential to change teacher-student interactions and facilitate personalized support for individual students by addressing their specific needs. Additionally, ChatGPT contributes to student engagement and motivation by generating thought-provoking questions that promote critical thinking and enhance curiosity and problem-solving skills."*
>
> Teacher B: *"I have not had the chance to witness ChatGPT's impact on personalized support for individual students, nor have I used it to address student inquiries, doubts, or misconceptions. However, if ChatGPT proves helpful in developing lesson notes that stimulate critical thinking and support the*

creation of engaging activities, it has the potential to enhance student engagement and motivation."

Teacher C: *"ChatGPT has a significant impact on teacher support, as it helps break down lessons into manageable content, easing the burden on teachers. In terms of student engagement and motivation, I have noticed differences in lessons that involve ChatGPT and IBL, with students actively participating throughout the lesson."*

Discussion

The first research question in this study delves into teachers' awareness of ChatGPT and how it influences their teaching practices. The study findings provide evidence that awareness of ChatGPT varies among teachers. Specifically, teachers in the JSS demonstrate limited awareness and usage of ChatGPT, while their counterparts in the SSS exhibit higher levels of awareness but still underutilize this technology. These findings highlight a critical correlation that teachers with higher levels of awareness of ChatGPT, whether acquired through professional development, training sessions, or personal exploration, are significantly more inclined to integrate ChatGPT into their teaching methods. This observation strongly suggests that professional development programmes and training sessions that introduce educators to ChatGPT and its potential applications can play a pivotal role in boosting adoption rates. This conclusion aligns seamlessly with the work of Atlas (2023) and Northwest Executive Education (2023), both argue that ChatGPT serves as a valuable tool for preparing teachers and professionals to recognize the transformative potential of AI across diverse fields, including education. Moreover, Chokshi (2023) advances the idea that incorporating ChatGPT-inspired workshops or trainings into professional development programs constitutes crucial step toward achieving this overarching goal. These workshops or training, as per Chokshi's perspective, serve as catalysts for educators, igniting their interest and deepening their understanding of AI's vast potential. However, the true success of this endeavor hinges upon the design of the professional development program. It must be crafted to not only impart initial insights but also to foster continuous learning and adaptation long after the workshops have concluded. This holistic approach necessitates ongoing support for educators in their journey to stay updated with the latest AI developments and effectively integrate them into their teaching practices.

The second research question in this study explores the extent of teachers' familiarity with the IBL approach and the 5E model and how this familiarity, or lack thereof, influences the integration of this pedagogical framework into their teaching practices. The findings reveal a diverse range of teachers' familiarity with the IBL approach and the 5E model. Teachers at the JSS and SSS have some level of understanding of the pedagogical framework. However, some have successfully integrated it into their teaching practices, while others still need to. This study did not determine what accounted for those familiar with the approach and are yet to integrate it into their teaching practice. However, this finding corroborates the study of Mukandayisenga et al. (2021), who found that despite having a positive attitude toward inquiry-based learning, teachers are relatively hesitant to put it into practice in their lessons. Furthermore, findings also reveal that 2 out of 15 teachers who participated in the study have extensive knowledge of the pedagogical approach and actively apply it in their teaching. This suggests that when teachers have a solid understanding of this approach and its contribution to student learning and outcomes, they

are more likely to integrate it into the classroom. This still boils down to continuous training and professional development, bridging the gap in teachers' awareness of IBL and equipping them with the knowledge and skills needed to implement the approach effectively. This aligns with the study of Hofer (2019) that teachers took a more positive attitude regarding IBL in general and its implementation after participating in the professional development programme.

Furthermore, the third research question in this study explores how teachers perceive the integration of ChatGPT into the IBL 5E model. The findings highlight that while some teachers have actively integrated ChatGPT into the IBL 5E model and are already experiencing its benefits, others are at varying stages of awareness and adoption. The interest and curiosity expressed by some teachers suggest a potential for broader adoption as educators become more familiar with ChatGPT's capabilities within the context of IBL. This aligns with the idea that technology integration often involves a phased approach, with early adopters paving the way for broader usage (Noroozi et al., 2012; Oke & Fernandes, 2020).

Moreover, this study fourth research question explores teachers' perceptions of the impact of integrating ChatGPT into the IBL 5E model on student engagement, learning outcomes, and teacher support. The findings shed light on how teachers view the integration of ChatGPT in the IBL 5E Model and its implications for teaching and learning. Integrating ChatGPT into the IBL 5E Model can positively impact various aspects of teaching and learning, including lesson planning, personalized instruction, question generation, student engagement, motivation, and teacher support. This assertion corroborates the findings that ChatGPT helps increase student motivation and engagement in the learning process (Kasneci et al., 2023; Muñoz et al., 2017; Nguyen & Cao, 2023).. However, it is essential to recognize that the extent of this impact may vary depending on teachers' experiences and the degree to which they have integrated ChatGPT into their teaching practices.

Conclusion and Recommendations

In conclusion, this study contributes novel insights into the awareness, adoption, and integration of ChatGPT within the context of the IBL 5E model. While existing literature acknowledges the significance of technology in education and the potential benefits of AI tools like ChatGPT, this study uniquely addresses the specific nuances of teachers' awareness levels and their practical incorporation of ChatGPT into pedagogical frameworks.

One distinctive aspect of this paper is its emphasis on the varying levels of awareness and adoption among teachers in both JSS and SSS. The study highlights a critical distinction: while teachers in SSS demonstrate higher levels of awareness, they still underutilize ChatGPT. This nuanced understanding of awareness and adoption patterns in different educational settings provides a nuanced perspective that can inform tailored strategies for professional development programmes. Furthermore, the study emphasizes the role of continuous learning and the need to foster positive attitudes toward pedagogical frameworks, particularly the IBL 5E model. While previous literature acknowledges the importance of ongoing teacher development, this paper specifically ties it to the effective integration of ChatGPT and emphasizes the importance of cultivating positive attitudes toward innovative pedagogies.

The recommendation for comprehensive investment in teachers' professional development, specifically tailored to introduce emerging technologies like ChatGPT, adds a practical dimension to the findings. The paper goes beyond recognizing the potential of ChatGPT, providing actionable suggestions for policymakers and educational institutions to prioritize and invest in programmes that facilitate teacher preparedness. Finally, the study recognizes the need to bridge the awareness gap regarding pedagogical frameworks like IBL and the 5E model. While other works might discuss the importance of these frameworks, this paper links this awareness directly to ChatGPT integration, emphasizing the interconnectedness of pedagogy and ChatGPT.

Suggestion for Future Research

Future research should conduct in-depth classroom observations to examine how teachers effectively integrate ChatGPT into the IBL 5E model and how this integration influences student engagement and learning outcomes.

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