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AI Teaching Assistants in Hybrid Learning: Strengths and Limitations in Healthcare Education

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Abstract. The rapid development of Artificial Intelligence has transformed higher education, offering innovative tools such as AI teaching assistants to enhance learning experiences. However, there is a lack of research exploring participants' views and experiences on AI teaching assistants in the South African context. This study explored students' views and experiences of AI teaching assistants in sustaining hybrid learning environments in health science education at a South African university. The Diffusion of Innovation model anchored in this study as a theoretical framework. The author adopted a qualitative case study design. Semi-structured interviews were utilised. A purposive sampling technique was employed to recruit six participants for this study. Thematic analysis was followed to analyse the data. Trustworthiness and ethical considerations were ensured. While AI teaching assistants offer significant benefits, their integration into healthcare education requires addressing ethical and technical challenges. Participants appreciated the in-time accessibility, personalised feedback, and interactive features of AI teaching assistants, which enhanced their engagement and flexibility in learning. However, they also highlighted challenges, including concerns about data privacy, content accuracy, and the lack of emotional support and mentorship from AI teaching assistants. The study concluded that a hybrid approach, combining AI with human teaching, is essential to maximise the potential of AI in education while preserving the human touch critical for mentoring and emotional support. Recommendations included providing comprehensive training, ensuring data privacy, and

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conducting pilot programmes to facilitate the successful implementation of AI teaching assistants in hybrid learning environments.

Keywords: hybrid learning; artificial intelligent; AI teaching assistants; acupuncture; health sciences

1. Introduction

The rapid development of Artificial Intelligence (AI) in recent years has gained increased attention globally in higher education as many countries attempt to adopt technologies to transform education. Therefore, Akinwalere and Ivanov (2022) indicate that AI has been largely accepted in the educational field. Rodway and Schepman (2023) believe the use of AI teaching assistants can significantly improve learning experiences for both students and educators at higher education institutions (HEI). More specifically, AI teaching assistants offer an opportunity to transform training with a clinical component in health science education (Narayanan et al., 2023). In this study, AI teaching assistants refer to AI-powered digital figures embedded with DeepSeek V3. Figure 1 illustrates an AI teaching assistant that was utilised at the identified university.

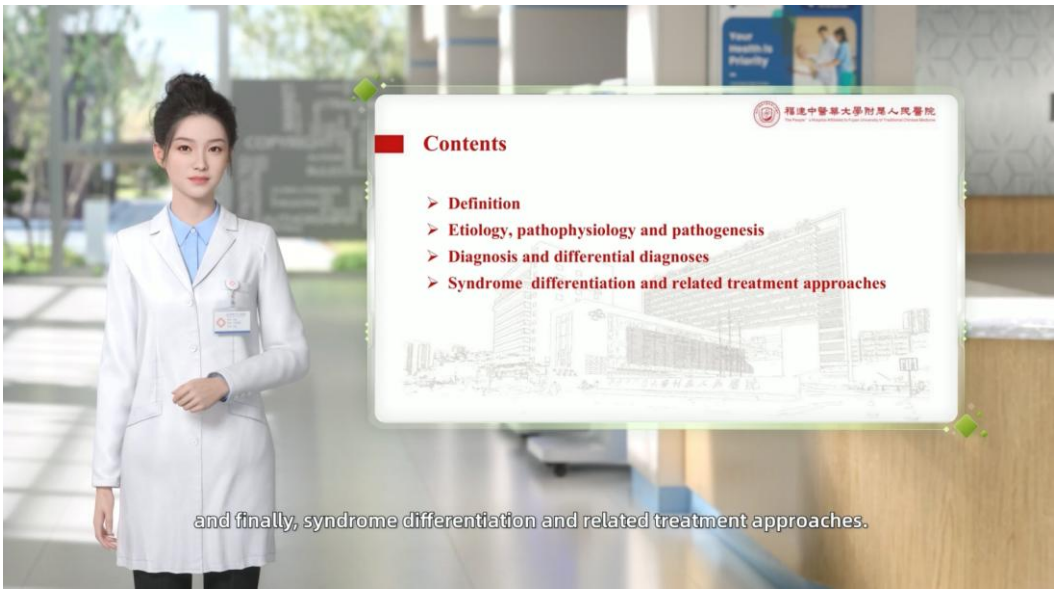

Figure 1. An example of AI teaching assistants embedded with DeepSeek V3

Literature reveals that AI teaching assistants provide various advantages in education. For instance, it can reduce the administrative workload of educators, offer continuous support to students and enhance student engagement (Deep, 2024). These innovation shares the benefit of flexibility in learning environments, making them increasingly compatible with the demands of hybrid learning (Eyal & Gil, 2022; Mulenga & Shilongo, 2024). Furthermore, the integration of AI into healthcare education allows for realistic clinical simulations, where students can interact with AI-generated patient scenarios, thus bridging the gap between theoretical learning and real-world clinical practice (Almansour et al., 2025; Sriram et al., 2025).

Despite these notable advantages, Eyal and Gil (2022) argue that there are challenges in the integration of AI teaching assistants into educational settings. For instance, data privacy, content accuracy, and the loss of the "human touch" in teaching are critical concerns that must be addressed for successful implementation (Eyal & Gil, 2022; Sriram et al., 2025). These concerns are particularly relevant in healthcare education, where the development of clinical decision-making skills requires emotional intelligence and mentorship, aspects that AI teaching assistants cannot fully replicate (Almansour et al., 2025; Sriram et al., 2025).

As such, the purpose of this article was to explore the advantages and challenges of AI teaching assistants in sustaining hybrid teaching environments, particularly in the context of health science education. This study explored the perceived benefits and challenges associated with AI teaching assistants in an acupuncture programme in a hybrid learning environment at a South African HEI. In this study, the author asked the research question, "How do students experience the use of AI teaching assistants in a hybrid learning environment?"

This study made several important contributions to the fields of educational technology and health science education, particularly within the South African higher education context. First, it addressed a notable gap in the literature by offering empirical insights into student experiences with AI teaching assistants in a hybrid learning environment—an area that remained underexplored, especially in developing countries. Second, by focusing on an acupuncture programme within health sciences, the study contributed to a more nuanced understanding of how AI can support clinical and theoretical training in specialised disciplines.

The findings provided evidence that AI teaching assistants could enhance student engagement, promote flexible learning, and offer timely feedback, thereby supporting the quality of education delivery in hybrid modalities. Furthermore, the study underscored critical limitations—such as emotional disconnect, concerns about data privacy, and issues of information accuracy—that must be addressed to ensure the ethical and pedagogical viability of AI in education. Lastly, the use of the Diffusion of Innovation model offered a theoretical lens through which the adoption and integration of AI technologies in higher education can be understood and evaluated, providing a foundation for future research and policy development.

2. Literature review

2.1 Introduction to AI teaching assistants

With the development of AI in recent years, global education has been transformed rapidly by introducing innovative teaching approaches. One of the most recent innovative transformations is the adoption of AI teaching assistants. These AI-powered systems are designed to facilitate both educators and students through personalised learning experiences (Jian, 2023; Tapalova & Zhiyenbayeva, 2022). Chu et al. (2023) explain that AI-powered systems provide a particularly valuable opportunity to promote clinical training in healthcare education. In the acupuncture programme at the identified university, AI teaching assistants have

been adopted and implemented in daily teaching activities to promote students' learning experiences.

AI teaching assistants can facilitate with various activities that traditionally need to be completed by human educators. From answering student queries to offering individual feedback, these virtual assistants have the potential to alleviate the administrative burden on instructors (Ajani et al., 2024). Joshi (2024) further highlights this was invaluable as it allows lecturers to devote more time to interactive and experiential learning activities. In a similar vein, Moorhouse et al. (2021) substantiate that AI tools can simulate patient interactions, helping students practice clinical decision-making in a risk-free environment.

Moreover, the accessibility of AI teaching assistants is one of the most noteworthy advantages in education. AI teaching assistants play an important role in hybrid and online learning settings, where medical students may be managing demanding clinical rotations alongside their studies (Ali et al., 2023). Slimi (2023) believes that AI systems can provide continuous support to students, addressing their questions and guiding them through complex topics at any hour of the day. Research shows that 24/7 AI access can improve student satisfaction and reduce cognitive load, as students receive immediate feedback and clarification on complex medical concepts (Ajani et al., 2024; Joshi, 2024).

Literature reveals that AI teaching assistants also improve student engagement through active interactions between digital lectures and students (Chu et al., 2023; Fazlollahi et al., 2022). Through interactive chat interfaces, gamified learning elements, and real-time feedback, these systems can create more dynamic and stimulating learning environments. In healthcare education, where the emotional toll of clinical practice can be high, AI-driven encouragement and progress tracking can help sustain students' motivation and resilience (Varnosfaderani & Forouzanfar, 2024). AI platforms that contribute to mastery of complex procedures or offer guided mindfulness exercises can support both academic and emotional well-being (Delello et al, 2025).

Despite a variety of benefits from AI, Tambuskar (2022) points out some challenges in the adoption and implementation of AI teaching assistants in education. Ramnani (2024) concurs those ethical considerations, such as data privacy and accuracy of the content knowledge, are crucial challenges to AI-driven teaching (Mennella et al., 2024). Additionally, while AI systems excel at handling routine tasks and providing immediate feedback, they cannot replace the human touch required for mentoring, emotional intelligence, and the nuanced decision-making intrinsic to healthcare education (Budhwar et al., 2022; Joshi, 2024).

2.2 Benefits of hybrid learning environment

Hybrid learning refers to the integration of face-to-face and online teaching which has emerged as a popular pedagogical approach in education (Ma, 2023). It shared strengths from both traditional face-to-face classrooms and digital learning. Gamage et al. (2022) state that flexible, personalised and inclusive learning

experience is the key advantage of hybrid learning. This is of particular significance in healthcare education as critical thinking, practical skills, clinical reasoning, and up-to-date knowledge are critical (Hu et al., 2022). Hybrid learning provides unique opportunities to bridge theoretical knowledge with clinical practice.

Furthermore, hybrid learning offers flexibility in the process of learning (Hu et al., 2022). Hybrid learning allows students to decided when to study according to their availability (Garba & Abdulhamid, 2024). This flexibility provides an opportunity for students to revisit content knowledge at their convenience. This view concurs with Munangatire and Indjabmba (2022) who report that asynchronous online modules improve knowledge retention in nursing education, as students can engage with material at their own pace and return to challenging topics. Hybrid learning further promotes student engagement and collaboration in teaching and learning. Digital platforms facilitate interactive learning through virtual discussions (Haleem et al., 2022). On the other hand, students still have an opportunity to participate in traditional face-to-face classrooms for practical training through hybrid learning (Gamage et al., 2022; Ma, 2023). This integration of online and face-to-face learning presents real-world clinical environments, preparing students for the collaborative, multidisciplinary nature of clinical practice (Medel et al., 2025).

From an institutional perspective, hybrid learning can lead to greater resource efficiency and expanded reach (Essa, 2023). Universities can optimise physical space for essential hands-on training while delivering theoretical components online (Papaioannou et al., 2023). This approach allows for larger cohorts without compromising practical learning opportunities (Garba & Abdulhamid, 2024). Additionally, online components enable access to global experts, virtual clinical rounds, and international healthcare perspectives, enriching the curriculum and broadening students' clinical insights (Lewis et al., 2024).

Despite the numerous benefits, it is important to acknowledge and address the challenges associated with hybrid learning. Ensuring equitable access to technology, providing comprehensive training for educators in digital pedagogy, and developing a sense of belonging among remote students are all critical factors for success (Javaid et al., 2024).

In healthcare education, preserving the integrity of clinical skill development in virtual or hybrid formats requires careful design and continuous evaluation (Hu, 2023). Hybrid learning represents a transformative shift in healthcare education, blending the best aspects of traditional and digital teaching methods (Mulenga & Shilongo, 2024). By offering flexibility, personalisation, engagement, and skill development, the hybrid model not only enhances the learning experience but also prepares future healthcare professionals to thrive in an increasingly complex and fast-paced clinical landscape.

2.3 Values of AI teaching assistants in hybrid learning environment

AI teaching assistants in hybrid learning environments plays a crucial role in improving learning experiences. The reason cited is that AI teaching assistants not only support students but also educators by improving accessibility through a hybrid learning environment (Cheng, 2024; Kovalainen et al., 2025). The use of AI teaching assistants in health science education breaks down barriers to education, enabling students to access teaching and learning anytime, regardless of their schedules or physical location (Saha & Mondal, 2024). This flexibility is valuable in Africa, where resources in health science education are limited (Hu et al., 2022).

Furthermore, the implementation of AI teaching assistants also enables educators to develop more engaging and comprehensive learning materials based on real-world clinical practice while ensuring patient privacy and confidentiality (Kovalainen et al., 2025). Because educators can use AI-generated patients to present clinical cases instead of using real cases from clinics (Saha & Mondal, 2024).

Therefore, AI teaching assistants can help bridge the gap between classroom learning and real-world clinical practice by integrating real-time clinical data and patient cases into the learning process (Kovalainen et al., 2025). This view concurs with Chu et al. (2023) and Tapalova and Zhiyenbayeva (2022) who articulate that AI teaching assistants can facilitate realistic simulations that allow students to practice clinical scenarios in a controlled, virtual environment. Simulated patient encounters powered by natural language processing and machine learning can help students practice consultations, diagnostic processes, and treatment planning without the immediate need for human patients or instructors (Furian et al., 2020).

Through AI-generated patients, context-rich scenarios that mirror the complexities of actual patient care can be presented to students through de-identified patient data (Mennella et al., 2024). This approach significantly improves students' clinical exposure and prepares them for the multifaceted challenges of healthcare delivery (Ajani et al., 2024).

3. Theoretical Framework

In this study, the author adopted the Diffusion of Innovation (DoI) model as a theoretical lens to explore health science students' views and experiences on the adoption and integration of AI teaching assistants in hybrid learning environments. The DoI model was developed by Everett Rogers in 1962 (Garcia-Aviles, 2020; Rogers, 1983). This model explains how innovations spread through a population or social system over time, influenced by factors such as communication channels, the nature of the innovation, and the social context in which adoption occurs (Vejlgaard, 2018). Through this model, the author aimed to gain in-depth understanding to strategically implement AI technologies to maximize their impact on student learning and clinical preparedness.

There are five key perceived attributes in DoI model, which are relative advantage, compatibility, complexity, trialability and observability (Bolici et al., 2020). Rogers (1983) defines relative advantage as the extent to which a new

technology is perceived as better than the existing solution (Garcia-Aviles, 2020). The more perceived benefit of the innovation is, the more likely it is to be adopted. These benefits include efficiency, cost-effectiveness, performance, or convenience.

Therefore, Min et al (2018) believe innovations that demonstrate a clear and significant advantage over current methods experience faster adoption rates. In educational technology, for example, AI-driven personalised learning platforms provide improved engagement, adaptive feedback, and efficiency, thereby increasing adoption among educators and institutions. Compatibility refers to how well an innovation matches the values, beliefs, experiences, and needs of potential users (Rogers, 1983). Dar (2018) points out that there is a need to ensure higher compatibility of an innovation to ensure smoother integration into existing systems and practices. This view concurs with Ho (2022) who emphrasises the importance of a smooth transfer of an innovation which requires minimal adaptation. Superior compatibility reduces uncertainty and increases adoption, especially when innovation aligns with institutional norms, educational policies, or technological infrastructure.

According to Mojaye and Aondover (2022), complexity refers to the extent to which an innovation is understood and used. The more complicated an innovation is, the more resistance it faces when introducing it to the public. Therefore, the simpler an innovation is to learn, use, and integrate, the faster it spreads. For this reason, Edler (2023) states that there are approaches to minimise the complexity of innovations, such as providing user-friendly interfaces, clear instructions, and minimal technical barriers.

Trialability refers to the degree to which an innovation can be tested or experimented with before full-scale adoption (Mojaye & Aondover, 2022; Rogers, 1983). Dar (2018) articulates that trialability plays an important role in promoting innovations as it reduces risk and uncertainty, making potential adopters more comfortable with the innovation. There are multiple approaches that can be used to improve trialability, such as pilot programmes, limited-access testing, or free trials (Edler, 2023). These approaches ensure users gain first-hand experience of innovations' benefits.

Furthermore, Ho (2022) highlights the significance of an innovation being visible to others which is known as observability. The more exposure to others through peer influence, testimonials or success stories, the better the innovations will be adopted (Bolici et al., 2020). For example, educators are more likely to adopt AI-based learning if they see demonstrated improvements in student outcomes, efficiency, and engagement (Edler, 2023). In this study, the author believed the DoI model provided a valuable framework for understanding how AI teaching assistants were adopted in health science programmes. It provided a structured lens through which to understand and facilitate the integration of AI teaching assistants in healthcare education.

4. Research Methodology

In this study, the author employed a qualitative case study design with an interpretivist paradigm to explore students' lived experiences on the use of AI teaching assistants in the acupuncture programme at an identified public university in South Africa. The interpretivist paradigm allows researchers to understand participants' lived experiences in a natural world setting (Razlog & Hu, 2024). A single case study design was utilised in this study as the identified programme was a unique programme in SA. Hu (2024) concurs with Yin (2018) who points out that a phenomenon that is unique, critical, unusual and relevant should be selected.

The identified case was critical because there was limited acupuncturist staff in the programme which might negatively influence the quality of the programme. The selected case was also unusual due to the fact that the AI teaching assistants were not widely utilised at South African HEIs. Furthermore, the selected case was relevant to the researcher as the researcher was an academic staff in the programme who had access to the phenomenon. In the identified case, AI teaching assistants were adopted in daily teaching in a hybrid learning environment. Students were taught both in traditional face-to-face classrooms and virtual collaborations.

4.1 Sampling technique and participants

A purposive sampling technique was employed in this study to recruit participants. The researcher displayed a research invitation poster on the notice board on campus. The researcher thereafter explained the research information to students who met the inclusion criteria. The inclusion criteria were: 1) they must enroll in the Complementary Medicine Practice 3 module of the Bachelor Degree of Health Science in Complementary Medicine; 2) they must sign the research consent form voluntarily; and 3) they must be above the age of 18. There were only 39 students enrolled in the module, resulting in limited responses to the invitation. Six students were recruited to participate in this study. Pseudonyms were utilised in the entire process of this study to ensure the anonymity and confidentiality of participants. Table 1 illustrated a summary of participants' demographic information.

Table 1. Participant's Information

Participants	Gender	Age
P1	Female	24
P2	Male	27
P3	Female	22
P4	Male	24
P5	Female	25
P6	Female	23

4.2 Data collection and analysis

Formal permission was obtained from the head of the department of the university before the commencement of this research. Hu (2024) states that semi-structured interviews allow researchers to explore in depth into research questions while maintaining the predefined guide. The author invited all participants to a semi-structured interview. The interviews took place between

February to March 2025. The data was transcribed and organised into themes according to the six-step thematic analysis (Zhang et al, 2024).

The six steps include becoming familiar with data, coding, generating themes, reviewing themes, refining themes, and writing up (Cohen et al., 2018; Hu, 2023). The trustworthiness of the research was ensured through multiple approaches, including member checking and an audit trail. Therefore, credibility, transferability, dependability, and confirmability of this study were achieved. This study received ethical approval from a research ethics committee at a public university in Gauteng Province (Reference: REC-1443-2022).

5. Results

Findings from this study highlighted that participants shared ambivalent views and experiences on AI teaching assistants in the hybrid learning environment. They concurred that AI teaching assistants benefited them and enhanced their learning experiences. On the other hand, participants also expressed challenges in the implementation of AI teaching assistants in their programmes. Two major themes emerged from the raw data during the data analysis, namely a) Participants' views and experiences of AI teaching assistants and b) Challenges in implementing AI teaching assistants in the hybrid learning environment. Verbatim quotes were included in the presentation of findings and discussions.

5.1 Theme 1: Participants' views and experiences of AI teaching assistants

Participants in this study shared ambivalent but generally positive views about the use of AI teaching assistants in their acupuncture programme. Many participants appreciated the accessibility and flexibility that AI teaching assistants provided, particularly in a hybrid learning environment where they balanced academic studies with clinical rotations.

For instance, P1 stated:

> "*I really liked that I could ask questions anytime, even late at night. The AI assistant was always there to help, which made me feel less stressed about deadlines*."

Similarly, P3 added:

> "*Sometimes I couldn't attend live lectures because I also worked part-time, but the AI assistant allowed me to catch up on the material at my own pace. It was like having a tutor available whenever I needed it*."

Participants also highlighted positive views on the interactive features of the AI teaching assistants, especially the real-time feedback.

P2 articulated:

> "*The AI assistant made learning more fun. It had quizzes that helped me remember key concepts, and the instant feedback kept me motivated*." P5 stated: "*I liked how the AI assistant would give me hints when I got stuck on a problem. It felt like a personalized learning experience, which helped me understand the material better*."

The findings suggested that AI teaching assistants held significant potential to enhance student learning experience through interactive and responsive features.

The positive reception of real-time feedback and adaptive support indicates that AI-driven tools can foster greater engagement and knowledge retention. Features such as automated quizzes and contextual hints appear to support a more personalized and efficient learning process, suggesting that AI can effectively complement traditional pedagogical strategies, particularly in content-heavy or skills-based subjects.

Despite the advantages, participants expressed concerns about the lack of emotional support in AI teaching assistants.
P4 said:

> "*The AI assistant was great for answering questions, but it couldn't really understand how I was feeling. Sometimes I needed encouragement or advice, and that's where human lecturers were better*." P6 added: "*I missed the personal connection with my lecturers. The AI assistant was helpful, but it didn't feel the same as talking to a real person who knows you and your struggles.*"

The concerns raised regarding the lack of emotional intelligence in AI systems highlighted a critical limitation in their current application. Participants' desire for encouragement, empathy, and human connection underscored the importance of maintaining a blended approach to teaching, where AI supports—but does not replace—human educators. These findings implied that while AI can be an effective tool for cognitive and procedural learning, it might fall short in addressing the affective dimensions of education, which are crucial for student motivation, well-being, and long-term success.

5.2 Theme 2: Challenges in Implementing AI Teaching Assistants in the hybrid learning environment in the Acupuncture Programme

Although participants acknowledged the potential advantages of AI teaching assistants, they also identified a range of challenges that hindered their effective use in hybrid learning. These challenges primarily related to data privacy, content accuracy, and the lack of alignment between AI systems and existing curricular practices.

Concerns about data privacy were particularly salient given the healthcare context, where students often engage with sensitive patient information during their training. Participants expressed uncertainty about how personal data were stored and accessed by the AI system, especially queries involving clinical content.
For instance, P1 stated,

> "*I was not sure how my data was being used. If the AI assistant is storing my questions and answers, who has access to that information? It made me feel a bit uncomfortable*."

Similarly, P3 noted,

> "*We work with real patient cases in our programme, so I was worried about how the AI system handles confidential information. I think there needs to be more transparency about data security.*"

While data privacy has been acknowledged in previous literature, its emergence as a priority concern in a localised, health-focused programme suggested the need for context-sensitive data governance protocols. In this regard, the significance of the finding lay not in the novelty of the theme, but in its implications for policy development and ethical standards within specific disciplines such as acupuncture and clinical training.

Content accuracy and reliability also emerged as a critical concern. Participants reported inconsistencies in the responses provided by the AI teaching assistant, leading them to question its dependability.
P2 observed,

> "*Sometimes the AI assistant gave me answers that did not seem right. I had to double-check with my lecturers, which kind of defeated the purpose of using it*."

P5 reinforced this view, stating,

> "*I noticed that the AI assistant sometimes provided incorrect information*."

This highlights a potential risk of overreliance on AI tools without appropriate oversight, particularly in disciplines where clinical accuracy is essential. The perceived trade-off between automation and instructional reliability was central to participants' cautious stance toward full AI integration.

A further challenge related to the integration of AI tools into existing pedagogical frameworks, especially in terms of user readiness. Several participants indicated they lacked the digital literacy or prior exposure needed to effectively interact with the AI system.
P4 explained,

> "*It took me a while to figure out how to use the AI assistant. I think more training would have helped*."

This was echoed by P6, who said,

> "*The AI assistant was useful, but it did not always align with what we were learning in class. Sometimes it felt like an extra thing to manage, rather than something that complemented our studies*."

These findings suggested that the integration of AI into hybrid learning is not merely a technological process but a pedagogical and capacity-building challenge. The study, therefore, identified a critical need for structured training and support for both students and educators to develop the necessary skills for effective AI use in educational contexts.

6. Discussion

The findings of this study revealed that participants held ambivalent views and experiences regarding the use of AI teaching assistants in a hybrid learning environment within the acupuncture programme. While they acknowledged the benefits of AI teaching assistants in enhancing their learning experiences, they also highlighted significant challenges in their implementation. These findings

align with existing literature, which underscores both the potential and limitations of AI in education, particularly in health science fields (Gamage et al., 2022; Medel et al., 2025).

Participants in this study reported that AI teaching assistants provided valuable support in their learning. In particular, the accessibility of AI teaching assistants allows students to receive immediate feedback and clarification on complex topics, which is beneficial in a hybrid learning environment where students are often busy with life and academic studies. This finding is consistent with Gamage et al. (2022) and Ma (2023), who found that continuous AI access reduces cognitive load and improves student satisfaction.

The ability of AI teaching assistants to provide continuous support addresses a critical gap in traditional education, where human instructors are limited by time and availability (Garba & Abdulhamid, 2024; Mulenga & Shilongo, 2024). This is especially relevant in healthcare education, where students often face demanding schedules and require flexible learning options (Medel et al., 2025).

Moreover, participants highlighted the interactive elements of AI teaching assistants as key factors in enhancing their engagement. These features create dynamic and stimulating learning environments, which are essential for maintaining motivation in rigorous academic programmes. Javaid et al. (2024) and Kovalainen et al. (2025) similarly emphasised the role of AI in promoting engagement through real-time feedback and interactive interfaces (Hu et al., 2022). In healthcare education, where the emotional stress of clinical practice can be high, AI-driven encouragement and progress tracking can help sustain students' motivation and resilience (Ajani et al., 2024; Jian, 2023; Joshi, 2024;). For instance, AI platforms that guide students through complex procedures or offer mindfulness exercises can support both academic and emotional well-being.

Despite the benefits of AI teaching assistants in supporting their learning, participants also expressed concerns about the AI systems. For example, while AI teaching assistants excel at providing factual information and simulating clinical scenarios, they cannot replicate the nuanced decision-making and emotional support that human educators offer. This limitation is particularly critical in healthcare education, where clinical reasoning and emotional intelligence are essential skills (Joshi, 2024; Moorhouse et al., 2021). Eyal and Gil (2022) and Mulenga and Shilongo (2024) argue that AI cannot fully replace the human touch required for mentoring and emotional support in clinical training. Participants in this study echoed this sentiment, noting that the absence of human interaction in AI-driven teaching sometimes left them feeling disconnected and unsupported in their learning journey.

Furthermore, participants identified several challenges in the implementation of AI teaching assistants, including issues related to data privacy, content accuracy, and the integration of AI with existing teaching practices. These challenges are consistent with the findings of Mennella et al. (2024) who emphasise the ethical considerations and technical complexities associated with AI-driven teaching.

Data privacy emerged as a significant concern, particularly in healthcare education, where sensitive patient information is often used in teaching materials. Participants expressed concerns about the potential misuse of data by AI systems, highlighting the need for robust data protection measures.

Content accuracy was another critical issue raised by participants. While AI teaching assistants can provide immediate feedback and support, their responses are only as reliable as the data they are trained on. Inaccurate or outdated information can undermine the credibility of AI systems and negatively impact student learning (Eyal & Gil, 2022; Saha & Mondal, 2024). This concern is particularly relevant in healthcare education, where up-to-date knowledge and evidence-based practice are essential. Institutions must, therefore, ensure that AI-generated content is regularly reviewed and updated to maintain its accuracy and relevance.

The integration of AI with existing teaching practices also posed a challenge for participants. Many students and educators were unfamiliar with AI systems, which created a barrier to effective implementation. This finding aligns with the DoI model, which identifies complexity as a key factor influencing the adoption of innovations. Rogers (1983) defines complexity as the extent to which an innovation is perceived as difficult to understand and use. In this study, the perceived complexity of AI teaching assistants contributed to resistance among some participants, underscoring the importance of providing comprehensive training and support to facilitate adoption.

The DoI model provided a valuable framework for understanding the adoption and integration of AI teaching assistants in the acupuncture programme. The five key attributes of the DoI model—relative advantage, compatibility, complexity, trialability, and observability—offer insights into the factors that influenced participants' experiences and perceptions. Participants recognised the relative advantage of AI teaching assistants in terms of accessibility, engagement, and clinical simulation.

These benefits align with Rogers' (1983) assertion that innovations demonstrating clear advantages over existing methods are more likely to be adopted (Garcia-Aviles, 2020). However, the absence of emotional intelligence in AI reduced participants' enthusiasm, indicating the importance of integrating AI with human teaching rather than using it as a standalone solution. The compatibility of AI teaching assistants with existing teaching practices emerged as a critical factor in their adoption (Min et al., 2018). Participants noted that the integration of AI into the curriculum required significant adjustments, which sometimes created friction. This finding underscored the importance of ensuring that innovations align with institutional norms, educational policies, and technological infrastructure to facilitate smoother integration.

The perceived complexity of AI teaching assistants contributed to resistance among some participants. Simplifying the user interface, providing clear instructions, and offering training can help reduce complexity and promote adoption (Ho, 2022). The ability to test AI teaching assistants before full-scale

implementation was identified as a key factor in reducing uncertainty and increasing acceptance. Pilot programmes and limited-access testing can provide valuable opportunities for students and educators to gain firsthand experience with AI systems. The visibility of AI teaching assistants' benefits played a significant role in their adoption (Edler et al., 2023). Participants were more likely to embrace AI systems when they saw demonstrated improvements in student outcomes, efficiency, and engagement. Sharing success stories and testimonials can help promote observability and encourage wider adoption.

The findings of this study have broader implications for the use of AI teaching assistants in hybrid learning environments, particularly in healthcare education. Hybrid learning, which combines face-to-face and online teaching, offers unique opportunities to bridge theoretical knowledge with clinical practice (Ma, 2023). AI teaching assistants can enhance this model by providing flexible, personalised, and interactive learning experiences (Garba & Abdulhamid, 2024). However, the challenges identified in this study highlighted the need for careful planning and implementation to ensure the successful integration of AI into healthcare education.

One of the key advantages of hybrid learning is its flexibility, which allows students to access learning materials at their convenience. This is particularly valuable in healthcare education, where students often have demanding schedules. AI teaching assistants can further enhance this flexibility by providing 24/7 support and enabling students to revisit challenging topics at their own pace. However, institutions must ensure that all students have equitable access to technology and the necessary digital literacy skills to fully benefit from hybrid learning (Hu, 2023).

Another advantage of hybrid learning is its ability to promote collaboration and engagement. Digital platforms facilitate interactive learning through virtual discussions, while face-to-face sessions provide opportunities for hands-on training and mentorship (Gamage et al., 2022). AI teaching assistants can complement these activities by offering real-time feedback and simulating clinical scenarios. However, the lack of human interaction in AI-driven teaching can sometimes undermine engagement, highlighting the need for a balanced approach that integrates AI with human teaching.

7. Conclusion and Recommendations

This study explored the role of AI teaching assistants in sustaining hybrid learning environments, particularly in the context of health science education, such as acupuncture in the South African context. The findings suggested that while AI teaching assistants offer significant benefits, including improved accessibility, engagement, and clinical simulation, their implementation is not without challenges. The lack of emotional intelligence, concerns about data privacy, and the need for effective integration with existing teaching practices are critical issues that must be addressed to maximize the potential of AI in education.

The study also highlighted the importance of balancing AI and human intelligence in healthcare education. While AI can enhance learning experiences and provide valuable support, it cannot replace the mentorship and emotional intelligence that human educators offer. Therefore, a hybrid approach that integrates AI with human teaching is essential to ensure the holistic development of future healthcare professionals. Based on the findings of this study, the following recommendations were proposed:

- Integrate AI and Human Intelligence: Institutions should adopt a hybrid approach that combines the strengths of AI teaching assistants with the mentorship and emotional intelligence of human educators. This can be achieved by using AI to handle routine tasks and provide immediate feedback, while human educators focus on mentoring, emotional support, and complex decision-making.

- Provide Comprehensive Training: To address the challenges associated with the implementation of AI teaching assistants, institutions should provide comprehensive training for both students and educators. This training should cover the technical aspects of using AI systems, as well as strategies for integrating AI into existing teaching practices.

- Ensure Data Privacy and Content Accuracy: Institutions must prioritize data privacy and content accuracy when implementing AI teaching assistants. This can be achieved by adopting robust data protection measures and regularly reviewing and updating AI-generated content to ensure its accuracy and relevance.

- Conduct Pilot Programmes: Before full-scale implementation, institutions should conduct pilot programmes to test the effectiveness of AI teaching assistants in specific educational contexts. These pilot programmes can help identify potential challenges and provide valuable insights into refining AI systems and teaching practices.

- Promote Observability and Peer Influence: To encourage the adoption of AI teaching assistants, institutions should promote observability by showcasing success stories and testimonials from early adopters. Peer influence can play a significant role in reducing resistance to new technologies and fostering a culture of innovation.

- It is further recommended to develop and implement comprehensive training programmes for educators and students focused on ethical use, technical skills, and effective integration of AI teaching assistants within the curriculum. Such training will equip all stakeholders with the necessary knowledge and competencies to confidently and responsibly use AI tools, thereby enhancing adoption and minimizing potential challenges related to data privacy, content accuracy, and alignment with learning objectives.

By addressing these recommendations, institutions can maximize the potential of AI teaching assistants in hybrid learning environments, ultimately enhancing the learning experiences of students and preparing them for the challenges of modern healthcare practice.

8. Limitations of this study

While this study offered valuable insights into the experiences of students using AI teaching assistants in a hybrid learning environment within the acupuncture programme, there were several limitations in this study. One of the primary limitations of this study was its small sample size. With only six participants recruited from a single cohort of the acupuncture programme, the findings may not fully capture the diversity of student experiences. Future research is advised to expand the sample size to ensure that the findings are more representative and applicable to a wider audience. The use of a single case study design in this study was another limitation. The reason was that the identified HEI was the sole institution that provided acupuncture programmes. While this approach allowed for an in-depth exploration of the phenomenon within a specific context, it also restricted the generalisability of the findings. A multi-case study design, comparing the implementation of AI teaching assistants across multiple programmes or institutions, could provide a more comprehensive understanding of their role in education.

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Appendix A: Semi-structured interview questions

1. Relative Advantage
   - In what ways do you think the AI teaching assistant improved your learning experience compared to traditional teaching methods?
   - What specific benefits did you gain from using the AI teaching assistant in your studies?
   - Do you feel that the AI assistant helped you achieve better academic outcomes? Why or why not?
2. Compatibility
   - How well did the AI teaching assistant align with your learning style and needs?
   - Did the use of the AI assistant fit easily into your existing course structure or learning routine?
   - Were there any cultural, institutional, or educational practices that made the integration of AI more difficult or easier?
3. Complexity
   - How easy or difficult was it for you to learn how to use the AI teaching assistant effectively?
   - Did you encounter any technical or usability issues when interacting with the AI assistant? If so, how did you address them?
   - What kind of support or training would have helped you use the AI system more effectively?

4. Trialability
    - Were you given a chance to try out the AI teaching assistant before fully integrating it into your learning?
    - Did the opportunity to experiment with the AI assistant influence your willingness to use it? How?
    - Would a pilot or trial phase have helped you feel more confident in using the AI tool? Why or why not?

5. Observability
    - Could you see clear results or improvements in your learning after using the AI teaching assistant?
    - Were you able to observe how other students or educators benefited from using the AI assistant?
    - How did seeing others use the AI assistant influence your own perceptions or usage?