

Assessing the potential of chatbots as tutoring tools in engineering education: A South African case study

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Abstract

Artificial Intelligence (AI) has emerged as a transformative force in education, offering the potential to tailor learning experiences to individual students. Within Engineering Education, AI-powered Chatbots like ChatGPT have shown promise as virtual tutors, providing students with personalized support. Utilizing natural language processing and machine learning techniques, ChatGPT can understand and respond to student inquiries, enhancing the learning process. This study aimed to assess the effectiveness of ChatGPT as a tutoring tool at a University of Technology in South Africa. We applied the Plan, Do, Check, Act (PDCA) cycle, a Quality Management tool, to explore the potential of integrating chatbots as tutors. A survey involving 48 participants was conducted to collect feedback from students who have interacted with ChatGPT. Our findings indicate that ChatGPT is an effective tool for personalized tutoring. It demonstrates the ability to understand and respond to student inquiries accurately and efficiently, thereby enhancing the overall learning experience. However, it is essential to acknowledge the ethical and societal implications associated with the use of AI in education. In conclusion, while AI, exemplified by ChatGPT, holds tremendous promise, it is important to recognize that human tutors continue to play a valuable role in education. A harmonious integration of AI tutors and human educators can offer a more comprehensive and holistic learning experience. This study serves as a foundation for future exploration of AI's role in education and the continuous improvement of such technology-enhanced learning environments

Keywords: Artificial intelligence, Personalised learning, Engineering education, ChatGPT

Introduction

Artificial Intelligence (AI) promises to revolutionize education by facilitating the occurrence of personalized learning experiences for students (Chassignol et al 2020, Luan 2018). In the context of Engineering Education, one promising AI application is the use of Chatbots, such as ChatGPT, which can function as tutoring tools to support students. ChatGPT leverages natural language processing and machine learning techniques to comprehend and provide responses to student queries. Research by Hsu & Ching (2023) advanced several advantages of using ChatGPT from a student perspective, such as the chatbot can provide personalized learning support and assist with reading and writing comprehension. Essentially, performing as a teaching assistant, tutor or complementary

learning partner. Intelligent tutoring systems or personalized learning systems, According to Akgun and Greenhow (2022), are of the most popular and worthwhile uses of AI to support students and teachers.

Interestingly, Chan and Tsi (2023) found that while AI holds tremendous potential, human tutors still offer significant value, and a combination of both AI and human tutors may offer a more comprehensive learning experience. This study aims to investigate the effectiveness of ChatGPT as a tutoring tool for Advanced Diploma students in the Engineering Faculty of a University of Technology in South Africa.

Findings suggest that although some believe AI may eventually replace teachers, the majority of participants argue that human teachers possess unique qualities, such as critical thinking, creativity, and emotions, which make them irreplaceable. The study also emphasizes the importance of social-emotional competencies developed through human interactions, which AI technologies cannot currently replicate. The research proposes that teachers can effectively integrate AI to enhance teaching and learning without viewing it as a replacement.

Departmental context

This case study examines the perceptions of a specific cohort of part-time students in the Faculty of Engineering at a Higher Education Institution (HEI) in South Africa. Part-time students, who are often working individuals with families, face unique challenges as they strive to strike a balance between their studies, their personal lives and professional responsibilities. These challenges include limited time availability for their studies, variability in course load that can impact their performance, and the need for flexible options such as evening or weekend classes to accommodate their conflicting priorities. Financial burdens and a lack of time for extracurricular activities further contribute to their distinct circumstances. Notably, the university's tutor policy, which involves older students acting as tutors, does not align well with the time constraints experienced by our part-time students who mostly are already full-time employed. Consequently, tutors have not been appointed for this cohort since the inception of the qualification.

Moreover, the student numbers have doubled over the last two years, and where tutoring has not been identified as a need before, it is no longer the case. The growing student numbers have necessitated online teaching which impacts student engagement (or lack thereof) and could pose further challenges for student throughput. This according to Ellis (2019) could be ascribed to a number of reasons including student backgrounds, needs, expectations and behaviors to name a few. This particular qualification has gained popularity in that it can be of value in both manufacturing and service industries and could be the reason for the large enrolment numbers. Although the student numbers have increased the teaching staff numbers have remained the same and this is one of the key reasons for the decision to continue with online teaching.

Primary Research Question

The primary research question for this study is "*What is the potential of chatbots, specifically ChatGPT, as tutoring tools in the context of Engineering Education at a selected HEI in South Africa?*"

Investigative Research Questions

1. What role does ChatGPT play in supporting and enhancing the traditional classroom instruction for engineering students?
2. How effectively does ChatGPT respond to student inquiries, and to what extent does it contribute to their understanding of engineering concepts and theories?
3. What ethical considerations arise from the use of ChatGPT as a tutoring tool in South African Engineering Education?
4. What are the potential future applications of ChatGPT and similar AI technologies in the field of engineering education?

Conceptual framework

The PDCA cycle, widely recognized as a continuous improvement model and quality improvement framework, in various sectors including business, education, and healthcare, serves as a valuable tool for systematic problem-solving and quality management. Its acronym, PDCA, represents the key phases: 'Plan', 'Do', 'Check', and 'Act', embodying a systematic and iterative approach to continuous improvement. While the PDCA cycle is traditionally associated with Total Quality Management, this framework offers a valuable model guiding our research.

In the 'Plan' phase of the PDCA cycle, users identify a problem, establish specific goals, and devise strategies to attain them. We have done this in considering ChatGPT's role in education within the context of our study. Subsequently, the 'Do' phase involves executing the plan on a small scale to assess its effectiveness. During this phase, during the examination of our case study, we explore Chatbot Usage and Learning Impact, evaluating the specific effects of chatbot usage in our context. Moving into the 'Check' phase, the process involves assessing outcomes against established goals, scrutinizing data, and pinpointing disparities, and in our case, this included Ethical and Societal Implications. Finally, the 'Act' phase entails making necessary adjustments and improvements based on insights gained, thus initiating the cycle anew. This phase in our study expands its focus to Future Applications and Feedback.

While the framework was originally conceived for quality control purposes, the versatility of it extends beyond quality management applications. Researchers such as Pietrzak and Paliszkiewicz (2015), Cowley and Domb (1997) and Maruta (2012) have employed the PDCA cycle in the examination of pedagogical strategies. Moreover, a distinctive aspect of the PDCA cycle, rendering it particularly suitable for research in the realm of learning, is its incorporation of both single and double loop learning - a concept originally proposed by Argyris and Schön (1978).

In the cycle, the single loop of learning involves incremental improvements to existing processes without questioning the underlying assumptions or goals. Essentially, it is making small adjustments to a plan to achieve better results. Double loop learning, on the other hand, involves questioning the fundamental assumptions and goals themselves. It goes beyond just adjusting the plan; it involves reevaluating whether the plan or strategy itself is effective and needs to be changed. Both incremental and fundamental changes in learning (Pietrzak and Paliszkiewicz, 2015), are crucial for the sustainability of organizations that want to learn and adapt effectively. Organizations need to make small adjustments when needed, but also reevaluate and change their entire approach when necessary to improve learning and performance. In this way the PDCA cycle is flexible, accommodating both types of learning (single and double loop) and therefore is valuable

for researching and improving learning processes within organizations, such as in our case study, especially during strategic management efforts.

Literature review

The role of chatbots in education

Chatbots according to Kooli (2023) are automated colloquial instruments that use ordinary language processing learning algorithms to engage with users in a social way. There is no question that AI, and more specifically chatbots have developed into change agents in education, offering the potential to modify learning experiences for individual students. When engaging with students, chatbots could take on multiple functions such as teaching agents, peer agents, teachable agents, and motivational agents (Chhibber & Law, 2019; Baylor, 2011)

Research into the application of AI in the classroom according to Dilmurod & Fazliddin (2021) and Megahed, Abdel-Kader & Soliman (2022), can be traced back to almost 30 years ago. Adaptive learning technologies and AI could be perceived as key enhancements in educational technologies (Chatterjee & Bhattacharjee: 2020; Ouyang & Jiao, 2021), however the growth of AI in higher education calls for concerns including those of an ethical nature (Guan, Mou & Jiang: 2020; Alam: 2022).

According to Holmes & Porayska-Pomsta (2022) and Ye, Sun & Li (2021), intelligent virtual reality, intelligent aid for group learning, and intelligent personal tutors are the three types of AI software solutions employed in education. They further believe that Intelligent tutoring systems (ITS) could impersonate face-to face or personalized tutoring, and this could be achieved from observing learner models, algorithms, and neural networks. Intelligent virtual reality (VR) according to Bhimdiwala, Neri & Gomez (2022) and Nalbant (2021) is used to engage students in simulated and game-based learning environments. In settings like remote or online labs, virtual human take on the identity of a lecture, teacher or tutor.

According to Alam and Mohanty (2023), many research studies allude to the fact that education is best accomplished in a group setting and therefore further put forth that collaboration and discussion is crucial to the educational process. This notion is supported by Bii (2013) who argues that chatbots have the potential to encourage collaboration amongst students.

Usage of chatbots and its impact

According to Alam and Mohanty (2023) professionals predicted a 43% increase in the use of AI in education between 2018 and 2022. Research done by Okonkwo and Ade-Ibijola (2021) and Wollny, Schneider, Mitri, Weidlich, Rittberger, & Drachsler (2021) revealed that educational chatbots have the potential to support students' learning experience. Chatbots for example could encourage students, get them to participate, and present them with immediate assistance (Okonkwo and Ade-Ibijola: 2021). Wollny et al. (2021) is further of the view that educational chatbots make education more accessible and understandable. Benotti, Martnez, & Schapachnik, (2018), argue that aside from chatbots being cost effective their popularity is also due to their ability to provide a personalized learning experience to a student.

Winkler & Söllner (2018) reported that Chatbot adoption could be fundamental in online classes that include large student numbers where individual support from educators to students could become demanding. It is further possible for chatbots to provide an understanding of knowledge gained in the form of immediate elaboration of course content (Cunningham-Nelson et al., 2019),

Cordeur (2023) argues that AI/ChatGPT represents a crisis. A crisis can lead to a unique opportunity. It requires teachers/lecturers to be innovative in their thinking about classrooms. ChatGPT has shaken academics out of their academic nap. There is no longer a place for handing out notes which students must memorise. A paradigm shift is required similar to the mind shift made with the arrival of the internet. To keep up with the rapid development of AI and remain relevant, education is forced to adjust their approach to TLA. Furthermore Cordeur (2023) argues that ChatGPT is “*here to stay*”. He adds that although there are concerns, educational institutions have no choice but to prepare for the world of AI. It would not be wise to discourage students from making use of it. Students will use it, just like they use smartphones, calculators and Google. Rather we (as educators) must equip students with the skills to use ChatGPT critically and responsibly, in which case it can follow the same route as previous AI models. Finally he notes that while ChatGPT is here to stay, it will never replace humans. Just like other software, it facilitates calculations but still requires human intervention to find the right answers (Cordeur 2023).

Ethical and Societal implications

Nakhooda (2023) proposes AI is a vehicle to drive social justice, reduce inequality, and positively transform our society. He argues that AI literacy has become increasingly important, and it's essential to recognize that individuals proficient in AI will enjoy a distinct advantage over those lacking AI skills, often referred to as “AI-illiterate.” To address this, a comprehensive reform of our educational curricula becomes imperative. He asserts that HE institutions must integrate AI literacy and practical AI knowledge using AI teaching methods across all academic disciplines, embedding them into teaching and assessment approaches. This transformation signifies a substantial shift in higher education, while still upholding core principles like student support, individual values, attention to diverse needs, and the holistic well-being of both educators and learners.

Kong, Cheung, and Zhang (2021) share a similar view to Nakhooda (2023) stating AI is already present in some curricula but is often concentrated in specific, context-bound fields like applied sciences and engineering, while AI's relevance extends across societal contexts. Therefore, the goal is to make AI literacy pervasive throughout our curricula, spanning humanities, social sciences, law, philosophy, and all other disciplines. Constructive and meaningful university policies should guide this interdisciplinary endeavor. Nakhooda (2023) purports to achieve this transformation, it's crucial for all South African universities to collaborate on a curriculum revision project that spans every discipline. This effort aims not only to uphold the principle of leaving no student behind but also to ensure that no institution is left behind, reducing disparities among universities and fostering AI expertise through collaborative national think tanks.

Atlas (2023) warns against several limitations when using language models, including ChatGPT, in higher education. These include the absence of acknowledging human emotions, intentions and moral reasoning, the probability of using the tool to cause harm for example to highlight societal issues like discrimination together with the likelihood

of these AI language tools to propagate existing societal inequities. ChatGPT could also be manipulated in ways that aren't aligned with human values and beliefs and then finally the issue of guaranteeing the quality of the final product are perceived as the major challenges with ChatGPT and similar language tools.

Future applications

Our literature review now advances to potential future applications of chatbots in education and casts a spotlight on areas of improvement. It relates to the forward-looking aspect of technology-enhanced learning and continuous refinement based on user feedback. Koivisto (2023) is convinced that there is no doubt that there are a variety of advantages to assigning trained tutors as academic counsellors. Tutoring, as proven to be an exhaustive exercise, additionally the advice from the different tutors could be inconsistent and finally tutors can also only avail themselves for restricted amounts of hours.

Given the named limitations of human tutors, Hwanga and Chang (2021) and Song, Oh and Rice (2017) argue that chatbots positively impacted students' enthusiasm and attentiveness to their studies, while Kowalski, Hoffman, Jain and Mumtaz (2011) and Bii (2023) are of the view that chatbots encourages student engagement and (teamwork) collaboration. Neumann, Rauschenberger, and Schon (2023) contend that future users of AI tools like ChatGPT are poised to become more productive due to the technology's supportive nature. Disregarding the advantages of AI tools could be detrimental to students and hinder the growth of higher education institutions (HEIs). The authors further advocate for the integration of AI tools like ChatGPT into HEI courses. Significantly, research conducted by Cronje (2023) on the use of chatbots as peer coaches revealed that the quality of feedback provided by the chatbot is contingent on the quality of prompts, emphasizing the importance of students' ability to reflect. ChatGPT, like traditional computers, adheres to the 'garbage in, garbage out' principle, delivering feedback based on its programmed responses.

Zhang and Aslam (2021) predicted that the proliferation of AI technology will inevitably make an impression in education and its relevance will certainly increase, ensuring the possibility to offer tailor-made learning, provide arduous assessments, and to enable important relations in online, mobile or blended learning encounters. Srinivasan (2022), believes that the role of teachers is being reimaged by the influence of digital technologies and AI tools, from being the primary source of knowledge provision to take on more of an instructor and facilitator role in a class room setting.

Methodological approach

In this case study, we designed an intervention centered around ChatGPT for a group of 132 Advanced Diploma students. The aim was to support them in completing a semester project, which accounted for 15% of their final module grade. To introduce students to ChatGPT's capabilities, the subject lecturer provided guidance on its use. Subsequently, students received a project brief and were granted permission to use ChatGPT to produce a 15-minute instructional video on a statistical concept as a group assignment. After receiving feedback on their draft submission, they were required to submit the final project within two weeks.

Following the intervention, we administered an MS Forms online survey to all students who used the chatbot ($n = 48$). This survey comprised 25 Likert scale questions and five open-ended questions. One of open-ended questions aimed to assess personalization (related to the 'Do' phase), while the remaining four open-ended questions sought insights on Future Applications (connected to the 'Act' phase). Certain questions were reformulated and repeated in the data collection instrument using different phrasings to ensure reliability and validity of data. Prior to data collection, we obtained informed consent from the students. Ethical clearance to do this study was obtained on the 12th June 2023 ([2023FEBEFREC-ST-004](#)).

For data analysis, we conducted descriptive statistical analysis using the MS Excel spreadsheet generated from the MS Forms data collection tool. Additionally, qualitative data obtained from the five open-ended questions were thematically analysed to identify emerging and recurring themes aligned with the four phases outlined in the conceptual framework.

Findings

The findings of this study are presented in an order directed by the conceptual framework, the PDCA cycle and consistent with the sequence of the research questions presented above. Thus, the findings of this study are presented in four sections which are (1) Plan: The role of Chatbots in Education; (2) Do: Usage of Chatbots and its impact; (3) Ethics and Societal Implications and (4) Future Applications.

Plan: The role of Chatbots in Education

In the 'Plan' phase, which focused on the role of chatbots in Education, several questions shed light on students' perceptions. When participants were asked if they found the Chatbot to be a valuable supplement to classroom instruction, responses varied: 25% agreed "definitely", 23% said "most of the time", and 17% responded with "some of the time". However, 25% expressed uncertainty, while 5% stated "never".

Regarding the Chatbot's ability to maintain student motivation and engagement in the course, 23% participants responses were affirmative with "definitely, yes", 19% responded with "most of the time" and 25% acknowledged "some of the time". Conversely, 6% indicated "no" and 27% were uncertain. When queried about the Chatbot's adaptability to their learning style and preferences, 25% confirmed "definitely", 23% cited "most of the time", 19% recognized "some of the time", 8% asserted "never", and 25% were unsure.

In response to the question about whether the chatbot fosters meaningful discussion and collaboration among classmates, 31% agreed with "definitely", 21% with "most of the time", 15% with "some of the time", while 6% firmly responded with "no, definitely not", and 27% remained unsure. Lastly, in terms of the chatbot's role in supporting knowledge acquisition, only 10% reported "to a very high extent", 27% "to a great extent", 36% "to a moderate extent", 6% "to a small extent", and 19% believed it did not contribute to knowledge acquisition at all.

Do: Usage of Chatbots and its impact

When participants were asked about the frequency of using Chatbots as tutoring tools, the data showed that 6% of participants used them daily, 29% a few times a week, 21% once a week, 17% monthly, and 27% never. When assessing whether the chatbot provided

personalized support tailored to individual learning needs, 48% of participants answered in the affirmative, 25% were unsure, and 27% indicated it did not. Regarding the chatbot's understanding of questions and appropriate responses, 40% of participants felt the chatbot understood their queries and responded effectively, while 19% said “most of the time”, 13% said “only some of the time”, 6% reported never, and 23% were unsure.

In terms of accuracy and relevance of chatbot responses, 31% indicated “yes, always”, 23% “most of the time”, 21% “some of the time”, 4% “never”, and 21% were unsure. Regarding the importance of immediacy in receiving responses from the chatbot tutor, 56% considered it extremely important, 19% “somewhat important”, 19% “neutral”, 4% “somewhat not important”, and 2% “extremely not important”. For the question concerning the chatbot's assistance in understanding concepts and theories related to studies, 35% felt it helped always, 21% “most of the time”, 17% only “some of the time”, 8% “never”, and 19% were unsure.

When asked if the chatbot provided sufficient explanations, 33% said “yes”, 19% “most of the time”, 21% “some of the time”, 4% “never”, and 23% were unsure. This was one of the questions that was asked in slightly different ways to enhance result reliability. Regarding confidence improvement in learning abilities, 27% felt more confident, 27% “most of the time”, 17% only “some of the time”, 8% “never”, and 21% were unsure. For the impact on grades, 17% said “yes” 25% said “most of the time”, 15% “some of the time”, 15% “no”, and 29% were unsure.

In terms of identifying weaknesses in knowledge or skill, 25% responded “yes”, 21% “most of the time”, 17% “some of the time”, 8% “no”, and 29% were unsure. For developing better study habits or improving time management skills, 27% answered “yes”, 17% “most of the time”, 23% “only some of the time”, 8% “no”, and 25% were unsure. Finally, when asked if additional human tutor or instructor support was needed while using ChatGPT, 29% said “definitely”, 33% “only some of the time”, 6% “most of the time”, 10% “no human tutor support needed”, and 21% were unsure.

Check: Ethics and Societal Implications

In the ‘Check’ phase, where we explored Ethics and Societal implications of ChatGPT, we inquired about participants’ stance on the ethicality of employing AI for supporting learning. Thirty-eight (38) % felt it was ethical, while 21% responded with 'most of the time.' Another 21% acknowledged 'some of the time,' while only 6% expressed a resolute 'no, never,' and 15% remained uncertain.

In response to our query about their comfort levels when utilizing Chatbots as tutors, only 10% expressed a firm “yes, definitely”, they feel uncomfortable when using ChatGPT. Examples of reasons provided by participant as to why they felt uncomfortable were “Does not giving sources of info” and “System does not give backgrounds maybe that's why i have doubts sometimes about an information provided to me. Maybe I need to educate myself more or use it frequently.” From the latter, we glean that the novelty of the technology may be the reason for the discomfort. Notably, only 6% report preferring traditional tutoring methods. Two (2) % leaned toward “most of the time”.

A significant 17% admitted feeling uncomfortable “only some of the time”, but the majority, comprising 48%, confidently declared they don't feel uncomfortable, and 23% remained uncertain. Subsequently, when assessing the extent to which the Chatbot

contributed to the production of high-quality course outputs, a noteworthy 19% firmly asserted “yes, definitely”, while an equal 19% predominantly stating “most of the time” Substantially, 29% indicated “only some of the time”, and a modest 8% unequivocally stated “no, never” Twenty-five (25%) were uncertain about the extent of its contribution to high-quality academic output.

Act: Future Applications

Perspectives shared by the research participants also provided valuable insights into the potential future applications of ChatGPT. Positive perspectives, such as “*ChatGPT is a tutor that can be accessible from home, bus, school, work*” and “*I imagine it as an around-the-clock tutor who can undoubtedly assist us with the world of work*”, highlight the enthusiasm for ChatGPT as a versatile and accessible learning tool that can support users in various settings.

However, it's equally important our participants highlighted challenges such as “The chatbot is not always giving you the correct answers” and “It can simplify and make one understand, but sometimes it just gives answers that don't make sense or are different from what you've asked” which underscores the need for ongoing improvements in accuracy and responsiveness of the technology.

Furthermore, the suggestion that “...*new information must be added, like regulatory requirements*” emphasizes the importance of continually updating and expanding the knowledge base of ChatGPT to ensure its relevance and effectiveness in addressing a wide range of user queries and learning needs. These insights collectively contribute to a more comprehensive understanding of ChatGPT's potential in future applications while highlighting areas for refinement and enhancement.

Participant responses also underscore the importance of two key aspects: awareness-building and user training. Their responses shed light on the need to enhance awareness and educate individuals on how to effectively utilize chatbots. Examples of participant responses regarding their workplace experiences and the skills gained through Chatbot interactions further emphasize these points. Comments such as “*The tool opened my eyes and had to ask my colleagues about it. Some were unaware had to educate myself and make others also aware of the tool*” along with “*So far the peers were unaware about the tool and some had to navigate to actually have an understanding what it does*” and “*To my surprise, some colleagues at work had not known about this excellent technology, which was definitely an advantage for me*” collectively highlight the need for proactive initiatives to promote awareness and provide training for chatbot utilization in both workplace and educational settings.

Discussion

Discussion on the role of Chatbots in Education

Consistent with the views of Holmes and Porayska-Pomsta (2022) and Ye, Sun and Li (2021), our study deduced that chatbots are a useful, supportive and flexible teaching tool. Most of our research participants (73%) found chatbots, ChatGPT specifically, to be a valuable supplement to classroom instruction, and only 5% stated that they did not believe it supplemented classroom instruction at all. We noted that participants were more divided on the ChatGPT's ability to maintain their motivation and engagement. They also had mixed opinions on the chatbot's ability to adapt to their learning style and preferences. Our respondents believe the chatbot fosters meaningful discussion and

collaboration among classmates, however the chatbot's role in supporting knowledge acquisition was moderate, as 36% reported "to a moderate extent," while only 10% reported "to a very high extent". We attribute this finding to the nature of our study, where students were tasked with creating a video based on concepts already covered in class. Consequently, the chatbots use was primarily knowledge consolidation, akin to the role of a tutor.

Discussion on Usage and Impact

Grounded in the forgoing discussion, we noted that only 10% of our research participants felt they did not need additional human tutor support when using the chatbot, and 68% indicated they prefer human tutor support in addition to ChatGPT. Significantly however, only 12,5% of the participants articulated that they were sceptical or fearful of AI tutors replacing human tutors. An inference made from this is that our research participants believe there should be a balance of human tutors and chatbots (AI tutors) support, with the immediacy of responses being cited as the top advantage (56%) of using chatbot tutors.

Reflecting on the overall impact of chatbots as tutors, this study concludes that the chatbot's ability to facilitate tailored learning experiences is a significant advantage as nearly half (48%) of participants highlighted this as a reason for using it as a tutor. A significant portion (40%) felt the chatbot understood their queries and responded effectively. The accuracy and relevance of chatbot responses were however a point of contention, with only 31% indicating that responses were consistently accurate and the remaining 69% held varying degrees of neutrality or opposing views on its accuracy and relevance (19% most of the time and 13% only some of the time). Despite this, 54% of the participants reported using the chatbot boosted their confidence and therefore, we deduce that in general the chatbot has more of a positive impact on learning and teaching. Aligned with the views of Cordeur (2023) and Nakhooda (2023), our study demonstrates that AI chatbots, such as ChapGPT, have established themselves in HE. The unfolding consequences of this are irreversible, akin to Pandora's box having been unsealed. These findings imply that, as HE educators, we must embrace innovative approaches when thinking about AI and how to integrate it into pedagogy. ChatGPT has shaken us out of an academic nap. Our findings remind us that HEI campuses have transcended their role as mere repositories for the dissemination of memorization-based study materials. Similar to the pivot that occurred with the arrival of the internet, a paradigm shift is once again required. To keep up with the rapid development of AI and remain relevant, the role of educators must be adjusted to make room for AI tutors.

Discussion on Ethics and Societal Implications

Significantly, most of our research participants did not feel it is unethical to use ChatGPT for their learning, and a similar majority did not experience discomfort when using this technology. Thus, our analysis of the findings of the check phase leads us to conclude that the primary reason for some students feeling uneasy may be the novelty of this new technology and the ambiguity surrounding its usage, particularly the absence of clear guidelines.

Furthermore, it's worth noting that most students expressed confidence in ChatGPT's ability to produce high-quality academic work. In line with Nakhooda's (2023) perspective, we assert that the increasing prevalence of AI, in particular ChatGPT presents a truly distinctive opportunity for universities to comprehensively rethink their

strategies and roles in our rapidly evolving world. As stewards of the knowledge economy, our institutions are compelled to take the lead in this transformation, actively shaping its course through introspection and meaningful actions. We believe this presents our best opportunity for fostering innovation and advancing social justice.

Discussion on Future Applications

Drawing on the findings of the 'Act' phase of this study, it appears that the advent of ChatGPT introduced a novel and valuable resource to the participants' workplace environments. A common theme emerges where many of their colleagues or peers were initially unaware of the Chatbot's existence or capabilities. This lack of awareness prompted the participants to take on the role of educators, sharing their knowledge and insights about the Chatbot with others in their workplace.

Furthermore, there is a consistent recognition among the participants that their familiarity with and utilization of the Chatbot provided them with a distinct advantage in their professional responsibilities. It empowered them to complete tasks more efficiently, such as writing Standard Operating Procedures (SOPs), and contributed to their overall competence in the workplace. Overall, the trend reflects the dual impact of the Chatbot: its introduction as a valuable tool that enhances individual productivity and its subsequent dissemination as users share their newfound knowledge with colleagues, thereby expanding its presence and utility in the workplace.

Recommendations for future research, theory and practice

Reflecting on the findings of this case study, we recommend future research on Chatbots in education should explore their adaptability to diverse learning styles and preferences, moving beyond knowledge consolidation. Moreover, at present there is a dearth in knowledge on the impact of Chatbots on motivation and engagement in classroom settings. Supporting other researchers (Cordeur, 2023; Nakhooda, 202; Holmes and Porayska-Pomsta, 2022 and Ye, Sun and Li 2021), it is evident that further research is needed on the integration of Chatbots into classroom instruction, as this is crucial for gaining a comprehensive understanding of their educational value.

We also believe understanding the ideal balance between human and AI tutor support, along with factors affecting the accuracy of Chatbot responses, requires further exploration. In terms of ethics and societal implications, future research should focus on developing clear guidelines to alleviate discomfort and ethical concerns among students. Additionally, examining the broader societal ramifications of AI integration in learning and their effects on educational policies is another recommendation of this study.

Finally, in terms of future applications of Chatbots, understanding the long-term impact of Chatbot integration in workplaces and assessing changes in productivity and efficiency is also a recommendation of this study. Future research exploring the knowledge and skills most effectively enhanced through Chatbot interactions in professional contexts would provide practical insights for future implementation.

Limitations for the study

We acknowledge that our case study has some inherent limitations. First, the rapid evolution of technology, particularly in the field of AI, poses a challenge. Despite our data collection efforts in July 2023, the landscape may have evolved since then,

potentially rendering our findings outdated to some extent. We acknowledge that if the survey were to be administered to students at a later date, the results might differ.

Second, our study focused on a single cohort within a specific department. As a result, the generalizability of our findings to broader educational contexts may be limited. While our research provides valuable insights within the scope of our study, caution should be exercised when applying these findings to different academic settings or student populations.

Conclusion

In a world marked by rapid technological advancements, the emergence of Chatbots such as ChatGPT, mirrors previous transformative shifts in HE, such as the internet's arrival. This has raised concerns regarding the potential overreliance on AI technologies like ChatGPT, with apprehensions about the displacement of human educators and the possible stifling of critical thinking skills.

Nonetheless, our study underscores the pressing need for a paradigm shift in educational strategies, incorporating chatbots in pedagogical approaches to remain pertinent and to harness the full potential of AI in education. As the custodians of the knowledge economy, educators and institutions must assume leadership roles in driving this transformation, actively guiding its trajectory through introspection and meaningful actions. This transition period we find ourselves in presents an unparalleled opportunity for fostering innovation and advancing social justice, and ultimately propelling the field of education into an era where human and AI collaboratively facilitate learning and knowledge dissemination.

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