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Research Article

Role of ChatGPT in Enhancing Safety Science Higher Education: Assessing the 4Ps of Pragmatism

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Abstract

The use of Generative Artificial Intelligence (GenAI) in the realm of scholarship of learning and teaching is considered a technological innovation for early higher educational adopters. However, whilst many benefits for its implementation in higher education have been proposed, the early stage of its adoption and integration into assessment design allows for a deep exploration into its value from the student perspective, a focus of this paper. Students from a leading North American University enrolled in Safety Science courses were surveyed to ascertain their views on the use of OpenAI's ChatGPT in their course assessments. Student responses were analysed in accordance with the 4Ps of Pragmatism (Practical, Pluralistic, Participatory and Provisional), a teaching philosophy adopted in the Safety Sciences. Results revealed that ChatGPT met the 4Ps of Pragmatism, suggesting its suitability for developing mastery and competencies in the fields of Occupational Safety and Health. Students were positive (p-value <.0001) toward the use of ChatGPT in their educational journey and as it contributed to enhancing their professional practice through stimulated thinking, problem solving and development of mastery and competencies. The integration of AI technology enhanced provisional learning whereby knowledge is advanced Through practical application, exploration, and iterative refinement.

Keywords: ChatGPT; Safety Science Education; Pragmatism; Occupational Health and Safety; Generative Artificial Intelligence

Introduction

Artificial intelligence (AI) applications adopted in higher education are changing the role of teachers [1]. Administrators have incorporated Generative AI (GenAI) in higher education to assist with admission applications, counselling, library services, intelligent tutoring, automated grading [2] course management, enrolment, retention, student support, advising, emotional support, and career services [3]. More recently, GenAI is being utilized to enhance the support for teaching and learning.[2] Companies such as IBM [4] and NAVIDIA [5] are providing free courses to aid in the adoption of GenAI including Large Language Models (LLM). Recently, Dempere., *et al*. [6] investigated ChatGPT, OpenAI's LLMs for its potential application in higher education. Their literature review revealed both benefits and risks. ChatGPT was recognized for its versatility in the educational sector, albeit not without associated risk. These factors included privacy breaches, misinformation, bias, misuse, accessibility issues and reduced human interaction [6].

ChatGPT is revolutionizing academic environments worldwide [7]. Many have concerns that ChatGPT and other chatbots (Generative Pre-trained Transformers) will replace human functions and people in the workplace including higher education [6]. Whilst it is being embraced by early technology adopters and some universities within the higher education space, it is providing a challenging situation for higher education institutions as they scramble to create new policies and adapt to its use by administrators, staff, faculty, and students, either with or without permission. To avoid such problems, some universities have banned the use of ChatGPT due to its potential for misuse [6].

The use of ChatGPT and other OpenAI applications in the educational space is relatively new with ChatGPT being launched at the end of November 2022 [6]. A systematic review of the implementation of ChatGPT in education conducted in 2023 revealed only 12 scientific studies from 2022 to June 2023 which examined

its impact, benefits, challenges, and areas of application in teaching and learning [7]. Similarly, a review by Aithal and Aithal [8] revealed that 11 scholarly articles focusing on the innovative and effective use of ChatGPT in higher education and research. In September of 2023, just a few months later, 93 articles and 51 reports were found related to the impacts of ChatGPT and other chatbots on higher education [6] where researchers found that ChatGPT can provide enhanced teaching through interactive personalized learning and feedback. Conversely, newspaper reports tended to focus on the adverse effects, highlighting the potential for students to engage in academic misconduct rather than recognizing its value as a learning tool [9]. One study found that 89% of students had used ChatGPT without authorization to complete homework, 48% on assessments or quizzes, and 53% for composition [6]. Despite these risks, ChatGPT has also been found to provide increased student engagement, collaboration, and accessibility [10].

In the Australian context, the Tertiary Education Quality and Standards Association (TEQSA) has mandated the use of GenAI applications and are closely monitoring how universities respond to the GenAI developments. They have requested reports from universities on how they are using or monitoring the use of GenAI with these reports being due by the middle of 2024. Australian universities are therefore beginning to embrace GenAI by giving access to staff and students while exploring its wider application amidst the rush to set rules that discourage academic misconduct due to the use of LLMs in student assessments. In Australia, the Australian government has established Australia's Artificial Intelligence Ethics Framework, which comprised of eight principles [11]. The ethical principles address eight domains of human interest: 1) human social and environmental wellbeing, 2) human-centered values, 3) fairness, 4) privacy protection and security, 5) reliability and safety, 6) transparency and explainability, 7) contestability, and 8) accountability. However, the framework lacks detailed guidance on how to put these principles into practice [12]. As a result, users continue to apply GenAI tools as they wish with little guidance from any source.

In the US, schools and universities are at odds with GenAI with many LLMs and chatbots readily accessible to students. Many K-12 school districts have banned GenAI including two of the nation's largest districts: the Los Angeles Unified School District in California, and the New York City Public Schools in New York. As of March 2023, 11 school districts in 10 states had banned GenAI in their schools [13]. Conversely, at Syracuse University, the administration is encouraging each discipline, professor, and class to set guidelines for use [14]. At Yale University, professors are expected to set course-specific rules on use while at the University of Pennsylvania's Wharton School requires students to use GenAI tools in classes [14]. Other universities have not yet taken a unified stance. For instance, the Montana University System have not yet established any policies on GenAI use. Each professor can establish their own guidelines in their specific courses [15]. At Montana Technological University, many professors are using GenAI in assignments and hence instigated this investigation.

Sullivan., *et al*. [9] noted that to date, there has been limited discussions on student views about GenAI tools and that there is certainly a need for more constructive student-led discourse on this matter.

To examine the utility of ChatGPT for higher education where courses focus on professional development, a Pragmatism teaching philosophy for the Safety Sciences was employed. The 4Ps of Pragmatism is a teaching philosophy that is particularly suited to students in educational programs of applied professional disciplines such as the Safety Sciences [16]. Pragmatism, as a teaching philosophy uses an experiential approach to orient teaching toward the student to discover what works as they solve practical real-world problems. Pragmatic teaching practice is student-centered to help students learn how to develop exploratory and provisional knowledge as applied to their professional competencies of knowing, understanding, and action. Pragmatism helps to solve academic identity issues common within the STEM fields and applied sciences. The tension occurs as industry professionals make the transition from discipline-based researcher to discipline-based SoLT education researcher [17,18].

The 4P's of Pragmatism teaching approach states that scholarship should be; Practical (useful and practical), Pluralistic (the study of phenomena should be multi and inter-disciplinary), Participatory (learning includes multiple stakeholders and different perspectives) and Provisional (experience is advanced by theory

into practice exploration, flexibility, and revision) and overlays Boyer's [19] scholarship reconsidered mandates of application, integration, teaching and discovery [16].

The study posed four research questions, each aligned with one of the 4Ps of pragmatism: (1) is the use of ChatGPT practical and useful for student learning; (2) does the use of ChatGPT enhance multi- and inter-disciplinary student learning (3) does the use of ChatGPT enrich multiple perspectives across various stakeholders (teachers, students, workplaces), and (4) does the use of ChatGPT provide provisional knowledge which can be enhanced through practical application, that is, through professional evidence-informed practice [16]. Therefore, this research aimed to examine the use of ChatGPT in Safety Science course assignment and assessment design to gain student's insight about their impressions and opinions related to the use of AI in OSH instruction. We asked students for feedback on the 4Ps associated with the scholarship of learning and teaching (SoLT).

Methodology

tool to guide pragmatic philosophy and its strength to blend disciplinary boundaries. Approval to undertake to aid the investigation's relevance to participant disciplinary studies, the research framework applied a pragmatic teaching philosophy lens to a mixed methods study [20]. The choice of Pragmatism is highly relevant due to its alignment with mixed methods methodology and widely accepted within the Safety Sciences as a functional this study was obtained from Central Queensland University, Australia, under the National Statement on Ethical Conduct in Human Research, 2023, Application No. 0000024715.

A questionnaire survey was developed and administered during the Fall semester in two courses at Montana Technological University: one at the undergraduate level, held on campus, and one at the graduate level, conducted online. The graduate student population were enrolled in Principles of Epidemiology (IH5246) and the undergraduates in Principles of Ergonomics (OHS454). A Likert scale 1 to 5 was used to assess the level of student's agreement with statements, where 1 = highly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, and 5 = highly agreed, see Table 1 statements relating to the 4Ps.

4Ps	Questions
Practical	The use of ChatGPT is practical and useful in student learning in the OHS/IH domain.
Pluralistic	The use of ChatGPT supports multi-interdisciplinary student learning in the OHS/IH domain
Participatory	The use of ChatGPT encourages multiple perspectives across various stakeholders, teachers, students, workplaces
Provisional	The use of ChatGPT provides provisional knowledge which can be enhanced through practical applications i.e. evidence-based/informed practice.

Table 1: Questions Focused on the 4Ps of Pragmatism.

Students were also asked four qualitative open-ended questions about 1) what else they would like to say about their experience in the use of ChatGPT, 2) what worked well, 3) what did not work well and 4) what improvements they would recommend for the future. Surveys and reminders were sent via the university Learning Management System (LMS) Moodle. The survey was sent in the latter half of the semester to 40 students, comprised of 20 undergraduates and 20 postgraduate students. Survey reminders were also sent prior to the conclusion of the semester.

Descriptive statistical analysis and frequency counts were generated. Within-question response variance was evaluated using the Chi-Square Goodness of Fit test for each survey question. A Bonferroni correction was conducted to reduce the alpha to account for variance. The null hypothesis was that question responses would match an equal distribution. The alpha was calculated to be 0.001 for significance.

Results

A total of 25 surveys were returned for a 62% response rate. All participants enrolled in either ergonomics or epidemiology courses during the Fall semester at Montana Tech. These students were instructed to assess and score the 49 quantitative questions using a Likert scale. Results are presented for the questions that related to the 4Ps of pragmatism followed by a discussion on the other research questions of interest.

P1 - Practical - teaching and learning should be useful

Participants were asked whether the use of ChatGPT was practical and useful in student learning in the OSH/IH domain. Results

showed that the majority of participants (90%) considered ChatGPT to be an effective tool for studying OSH/IH subjects, with 68% (*n* = 17) strongly agreeing and an additional 24% (*n* = 6) in agreement. Only one participant (4%) remained neutral, and one participant (4%) disagreed with the assessment. Chi-square goodness of fit test showed that the observed frequencies differed significantly from an equal distribution. After applying a Bonferroni correction to adjust for multiple comparisons, the results indicated a statistically significant difference Chi-Square (3, N = 22) = 42.09, p < .001, with an effect size of Cramer's V = 1.0. These results indicate most participants found ChatGPT to be a practical way to learn within the OSH/IH disciplines.

P2 - pluralistic- teaching and learning should be multi - interdisciplinary

Participants were asked if the use of ChatGPT supported multi/interdisciplinary student learning in the OSH/IH domain. Again, results showed that most (88%) participants found Chat GPT useful for learning multi-and interdisciplinary topics. Sixty-eight percent (*n* = 17) highly agreed, and 20% (*n* = 5) agreed. The remaining three participants represented (12%) neither agreed nor disagreed. Again, analysis showed a statistically significant difference between participant ratings Chi-Square (3, N = 22) = 35.72, p < .001, with an effect size of Cramer's V = 1.0. Overall results on ChatGPT being pluralistic were positive.

P3- participatory - teaching and learning should include multi stakeholders

Participants were asked if the use of ChatGPT promotes diverse perspectives among stakeholders such as teachers, students, and workplaces. Results showed that 48% (*n* = 19) of the participants highly agreed, 36% (*n* = 14) agreed, 12% (*n* = 5) neither agreed nor disagree and 4% (*n* = 2) highly disagreed. Again, analysis showed a statistically significant difference between participant ratings Chi-Square (3, N = 22) = 21.18, p < .001, with an effect size of Cramer's V = 1.0. These results confirm an unequal distribution.

In general, the outcomes regarding the participatory nature of ChatGPT were favorable, albeit to a lesser extent when compared to the earlier inquiries.

P4 - Provisional - learning and knowledge are advanced by practice exploration

Participants were asked whether the use of ChatGPT provides provisional knowledge which can be enhanced through practical application i.e. evidence-based informed practice. Results showed this to be true for all participants, where 64% (n = 16) highly agreed and 36% (*n* = 14) agreed. Again, the null hypothesis is rejected. Again, analysis showed a statistically significant difference between participant ratings Chi-Square (3, N = 22) = 37.33, p < 0.01 with an effect size of Cramer's V = 1.0.

Thematic analysis of the qualitative responses revealed participants found ChatGPT useful in several areas.

Students were invited to share their thoughts through open-ended questions, including any additional comments, aspects that were successful, areas that could be improved, and suggestions for future programs. The feedback received was limited but valuable.

The analysis revealed five matters that influenced participant learning in the OHS/IH discipline, namely: Efficiency, Educational Tool, Usability, Specificity, and Ethical Considerations. For each of these matter, representative quotes are presented, to illustrate participant perspectives on ChatGPT for learning via assessment within the OHS/IH discipline (Table 2).

The analysis and representative quotes show that ChatGPT is perceived as a highly efficient and user-friendly tool that enhances learning and provides quick, organized information. However, participants also raised ethical concerns, particularly as an educational tool where issues of plagiarism and quality of sourced material is important. Finally, the results showed that more nuanced responses can be achieved through specific prompts, which was a skill that developed over time.

When, asked 'what worked well? Analysis revealed similar themes, in four categories, specifically: Efficiency, Clarity, Functionality, and Usability. The findings indicated that participants valued ChatGPT for these attributes (Table 3).

Participants were also asked to comment on "what did not work well while using ChatGPT". Three areas stood out, relating to Information Limitations, User Experience, and Functionality (Table 4). When considering what worked and what did not, comments reflect mixed experiences in the user experience, and functionality areas. Some users praised ChatGPT for its ease of use, while others experienced delays in loading responses and had to load data manually due to upload functionality of the free version. Similarly, participants found ChatGPT's functionality could handle specific questions well, though its automated thinking process was not always

Matter	Quotes
Efficiency	"It saved a huge amount of time in analysis, research, and collection for OSH." "ChatGPT can find information very quickly, which really helped me to the learning process" "Organized and direct. This minimized the need to search through text to find what I was looking for."
Educational Tool	"It was an innovative experience for me because I didn't realize how versatile ChatGPT is." "It is a helpful tool and very interesting to use" "… One of the most time-consuming parts of learning something new is not knowing where or what to look for. I used ChatGPT as a supplementary tool to gather ideas. ChatGPT also helped me reaffirm information that I have read/learned before but forgot where I learned it".
User Experience	"Very helpful" "It was super easy to use and gave me knowledge & ideas."
Specificity	"Being as specific with your questions helps with results" "If you keep asking questions to the same chat, it will slowly develop a unique writing style." "With correct prompts, ChatGPT can modify what it has already done. I found that allowing it to summarize what it said, and again a third time to get a concise answer."
Cautionary Considerations	"I am too concerned to use it to help with assignments, I worry about plagiarism and quality of its source material." "For homework, I think it was more cheating than learning. For work, I see greater applicability." "ChatGPT is not always correct. When using it to check my answers on other homework, it was often incorrect…It reminds me of Wikipedia-you can use it to get a basic understanding of a topic but, you can't count on it to be 100% accurate".

Table 2: Learning within the OSH/IH discipline with ChatGPT.

Theme	Quotes
Efficiency	"Did homework easier" "Gaining information fast without scrolling through the internet" "Using it to create study guides"
Clarity	"It summarized the articles well and gave easy to understand summaries" "The answers were very clear"
Functionality	"Analyzation, research, proofreading, evaluation" "It did not always answer all the questions…"
User Experience	"It all worked well." "User friendly - builds on previous responses"

Table 3: When Using ChatGPT, What Worked Well?

Theme	Quotes
Information Limitations	"The free version of ChatGPT only has information renewed to 2021" "Short summaries and most recent data were up to 2017."
User Experience	"Took a while to get answer to load." "Results varied significantly depending on what words were used. Couldn't upload documents for review, had to copy paste."
Functionality	"It does a lot of thinking for you, which has pros and cons." "Getting specific questions answered."

Table 4: What Did Not Work Well While Using ChatGPT?

considered advantageous. Information availability and recency was also a notable disadvantage in addition to extended response times and challenges in obtaining precise answers due to functional limitations, there was a significant drawback, particularly with the free version of ChatGPT.

Finally, participants were asked to offer recommendations based on their experience. Recommendations centred around their educational needs and included continued use of ChatGPT as a tool, as well as incorporating learning activities or discussion questions to enhance student development of critical thinking.

Discussion

This research explored student perspectives on the use of ChatGPT for assessment within the OSH/HF domains. Integration of ChatGPT into assess was used to test its alignment with the 4Ps of Pragmatism. Most of the published literature is focused on the current and potential uses of GenAI and the benefits to governments, businesses, industries, and education. The higher education focus has been predominately on applications for administration, staff, and teachers, as well as the perceived benefits to students and not necessarily to investigate the student perspectives. AI has permeated numerous industries including higher education.

Investigators conducted a systematic literature review and found AI applications in higher education for teaching and learning enhancements, instruction, knowledge management, ontologies, student grading and evaluations, student retention, dropout prediction, sentiment analysis, intelligent tutoring, learning music, and research [21]. Another team of researchers conducted a literature review focusing on AI's impact and changing roles in higher education [8]. They found eight articles addressing changing roles that included the impact on foreign languages, transformations in pedagogy, learning occupational tasks, and the future of work. They concluded that AI would increase access to education, improve learning experiences, increase efficiencies, and provide personalized learning, improved collaboration, and communication. They believe that AI will play a major role in evolving pedagogy. Authors outlined student benefits that included personalized responses, natural language processing, instant feedback, accessibility, and flexibility concluding that AI will complement traditional teaching and give students a powerful new tool for learning and exploration [8].

Researchers in this study created assignments in two university courses requiring students to use ChatGPT to deepen their knowledge, skills and abilities on a variety of topics within ergonomics and epidemiology. Students completed 14 assignments in each course using the AI tools. We learned a great deal about the student experience using ChatGPT or other LLMs when completing assignments. The students had an overwhelmingly positive experience. Specifically, we found strong support for the 4Ps of Pragmatism. Ninety-two percent (92%) felt that AI tools were practical and useful in student learning in OSH/IH, p-value <0.001. When asked if the tools promoted multi/interdisciplinary (pluralistic) learning, 88% responded that they strongly agreed or agreed, p-value <0.001. Students overwhelmingly (84%) reported that AI supported participatory learning and encourage multiple perspectives across stakeholders, p-value <0.001. Most importantly, 89% highly agreed or agreed that AI tools would enhance their (provisional) skills for practice, p-value <0.001, and provide quick access to evidence-based facts and concepts.

In contrast, Church [22] reported that using LLMs in his class for a natural language processing homework task led to misleading information being provided to students. The responses contained numerous inaccuracies described as "hallucinations." Despite being advised to fact-check the essays generated by ChatGPT, most students did not verify the information and tended to believe the AI-generated content due to its authoritative manner [22]. The research found that ChatGPT and other LLMs had strengths and weaknesses. Findings suggested that ChatGPT was very good at choosing metaphors and documentation, useful for outlines, gave poor directions, and was very bad at quotes, references, and perspectives [22].

In our study, we received limited feedback that ChatGPT was not always correct, and it was very bad at math. Students also reported that ChatGPT was limited to information prior to 2021. Our findings were consistent with those of Dempere., *et al*. [6], who found that ChatGPT could have as much as 30% errors in responses. Sandu and Gide [22] surveyed 47 students and reported that 77.8% of students were worried about receiving incorrect advice and 66% were concerned about losing personal information. Cotton., *et al*. [10] submitted a question to ChatGPT3 asking how to improve the message and received sound advice; 1) review and revise the text, 2) check for factual accuracy, 3) incorporate your own ideas and analysis, 4) use proper citation style, and 5) edit and proofread.

Researchers have also found that while LLMs were easy to use, 63.8% of respondents preferred working with real people [23]. We did not ask about the preference of interface in our study. Others have identified isolation as a potential barrier to long-term AI use

[24]. While ChatGPT provided personalized learning, it was felt that it could not replace human interaction. The separation from others was also identified as a potential barrier to collaboration [24].

Students reported that using AI tools was the quickest method for communicating to their institution [23]. In fact, 93.6% of participants reported that they were less likely to use other means of communication if they were using LLMs. This correlates with the feedback that we received indicating that ChatGPT was easy to use. For example, in the service industry investigators have found increased efficiency in problem-solving for complaints and inquiries using AI tools [25]. They also discovered that AI is user-friendly and maintains a high-level consumer satisfaction at 79.6%. The company being studied had implemented AI to examine and analyze the behaviors of the high-producing agents. The program could then duplicate the behaviors robotically and train low producers how to be more effective and efficient with their time and calls [25].

In the present study, students did not overwhelmingly feel that ChatGPT was good for analysis or evaluation, p-value 0.021 and 0.011 respectively. Yet, 72% and 76% respectively indicated that AI tools did cause them to think about analysis and evaluation. This was not a request for completing assignments. However, data analysis is a huge strength of AI [26].

Students did feel that AI tools were useful for problem-solving. However, most undergraduate students were not currently employed and may have been unable to gauge this question or applied the technology to their life problems.

We identified other interesting findings related to the development of mastery and competencies, the practice of collaboration for problem-solving. In the current study, students were reserved about the value of ChatGPT and the ability to collaborate with others to solve problems, this might have been because assignments were completed individually and not designed to require collaboration. Both courses did include collaborative projects, but no effort was made to assign AI tools on these project assignments. Zawacki-Richter., *et al*. [2] reported that a major strength of AI was intelligent support for collaborative learning. Authors went onto say that online collaboration had to be facilitated. AI technology can contribute to collaborative work through group formation based on learner models and may be used to facilitate online group actions as well as summarizing group discussions [2]. Cotton, Cotton and Shipway [10] also identified ChatGPT as a good tool for student collaborations through AI-formed groups where students worked together to complete assignments. Investigators also described the potential for plagiarism on individual assignments and offered several strategies to reduce the chances for cheating including: 1) educating the students about plagiarism, 2) requiring students to submit their work drafts as well as the final paper, 3) using plagiarism detection tools, 4) setting clear guidelines for use of ChatGPT and other sources, and 5) monitoring student work closely [10]. De la Higuera and Iyer [27] published an open textbook on AI for teachers that may help guide users in the new age of digital learning and teaching.

The present study was focused in exploring student perspectives. Others have identified the pros and cons of ChatGPT [26]. The pros are a long list of attributes and possibilities. The cons are also a long list and includes ethical concerns such as cheating, security risks, privacy assurance, and dissemination of false or incorrect information [26]. ChatGPT and LLMs have much to offer all stakeholders in higher education with the caveat to be aware, diligent, and check results.

Conclusion

The rapid technological advancements in Artificial Intelligence are revolutionizing the landscape of learning and teaching in universities worldwide. As universities navigate this wave of change, some are embracing AI tools like ChatGPT and LLMs as early adopters, while others are treading cautiously into this new realm. A case study presented here delves into a university's integration of ChatGPT and LLMs into assessment designs, specifically within the domain of Safety Science. Students engaging with ergonomic and epidemiology courses were exposed to these AI technologies and later provided feedback. Their responses were overwhelmingly positive, highlighting how the use of ChatGPT enhanced their professional skill development through critical thinking, problem-solving, and competency building. Students acknowledged the practical benefits of ChatGPT in their learning journey, fostering provisional learning through practice, exploration, and revision. Moreover, they recognized ChatGPT's contribution to their practical application of scholarship, making it a crucial tool in their progression towards professional work. Additionally, students appreciated how ChatGPT facilitated interdisciplinary interactions, known as pluralist integration, and encouraged participatory learning by incorporating diverse stakeholder viewpoints. In essence, the integration of AI technologies like ChatGPT and LLMs is reshaping the educational landscape, empowering students to enhance their skills, expand their knowledge, and approach learning from a more collaborative and holistic perspective.

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