

The Use of Generative Artificial Intelligence in Higher Education

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Abstract

ChatGPT is one of the most popular forms of artificial intelligence that is being used to support student learning. How ChatGPT and other generative artificial intelligence (gAI) apps are being used by students is largely unknown given their relative newness on campus. Hence, the purpose of this study was to examine what gAIs are being used, how they are supporting student learning, and what are students' perceptions about gAI's impact on learning, privacy, and ethical considerations. Two hundred and fifty-three students in higher education completed the survey. Findings revealed that students used gAI for a variety of purposes, including general learning support, assistance with writing assignments, solving homework questions, and generating ideas. There were several statistically significant differences in mean scores, including differences in perceptions towards the impact of gAI on learning grouped by frequency of gAI use and status as a domestic or international student.

Key Words: Generative Artificial Intelligence, ChatGPT, Chegg, Privacy, Ethics

Introduction

Recently, the field of artificial intelligence (AI) has grown at an unprecedented rate, fundamentally changing landscapes in healthcare through to finance (Bajwa et al., 2021; Almutairi & Nobanee, 2020). This technological revolution has not spared the education sector, where AI's impact is becoming increasingly visible. Grammarly was once a common AI with a fixed set of pre-defined grammar rules that was accepted in higher education as a tool for students to use and improve their writing (Zinkevich & Ledeneva, 2021). Although Grammarly is still in use, the emergence of popular advanced generative artificial intelligence (gAI) tools such as ChatGPT (OpenAI) (n.d.), Google Gemini (Google), and Claude (Anthropic) (n.d.) - to name a few, represents a significant change in the way students access and generate information. Not only can gAIs improve students writing, but they can also generate an entire assignment, and if students do not have time to read a book assigned for class, gAI can provide a summary of key points. These are just a couple examples of how gAI can be used in higher education. Despite the immense popularity of gAI tools, their potential impact on students' learning is not fully understood. For example, we know little about how students perceive gAI is impacting their learning, their awareness of privacy related to gAI use, or whether they consider any ethical implications related to gAI use. Generative AI are instructors are also concerned about students use and abuse of these technologies for learning and completing assignments. Unsurprisingly, these concerns have prompted discussions about students' ability to learn and their preparedness for the future (Foltynek et al., 2023).

There is insufficient data on what gAIs students use and how they use these tools, despite many studies that have examined how AI in general can improve education, particularly in

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higher education (Bond et al., 2024). Advocates for gAI have envisioned the tool's benefit for the sector. Dr. Wang of UNESCO Asia mentioned how gAIs can transform language classes by creating interactive scenarios such as role-play exercises for second language students as a typical example (MSM Reporter Bureau, 2023).

To maintain academic integrity and guarantee the effectiveness of teaching and learning, it is critical to know, at this early stage of gAI use, how students use gAI tools to support their learning. This insight is necessary to ensure that educational policies, strategies, and assessment practices are relevant. Thus, the purpose of this study was to investigate the extent of gAI usage among university students in completing course assignments and aiding their learning. The findings from this study will provide a baseline from which students' changes in gAI use can be measured.

The research questions posed in this study are: What gAIs are being used by students in higher education, and how are they using gAI to support their learning? To what extent does gender, faculty, program (grad/undergrad), status (domestic/international) and frequency of gAI use, influence perceptions about the impact of gAI on learning, privacy, and ethical considerations? Given that graduate students tend to be more independent than undergraduate students who may have more supervision (Magnusson & Zackariasson, 2018), combined with the notion that many graduate students are producing original work, it is possible that graduate students may be more cautious and aware of the implications of gAI use. It is also likely that students who have more experience with gAI will respond differently than those who do not; however, we are uncertain as to whether students with more experience with gAIs would be more hesitant or cautious towards gAIs. This study was approved by the Research Ethics Board, certificate #6012393.

Literature Review

Generative AI (gAI) is a type of artificial intelligence technology that can be trained on data to produce new content in the form of text, image, audio, and video (Martineau, 2024). Although gAI had its foundations in early natural language processing research, the past few years have witnessed rapid advances leading to more sophisticated content generation models and applications (Johri et al., 2021; Takale et al., 2024). The impact of gAI has become noticeable in education, potentially reshaping traditional teaching and learning (Kadaruddin, 2023). There is still much to learn from understanding how students are adjusting to this technology.

OpenAI's ChatGPT is one of several examples of gAIs that have become exceptionally popular in education since its release in November 2022 (Fütterer et al., 2023). Students can prompt ChatGPT with a few key ideas or sentences and ask it to write a five-paragraph essay that is four pages long. They can tap into the power of gAIs further and customize them by uploading a full course textbook and then ask the gAI to provide responses based on a specific context from the book or to take on the persona of the author to answer subsequent questions (this compliance with copyright laws is left for later discussion). Moreover, these gAI tools, powered by sophisticated algorithms, are not only assisting in administrative and operational tasks but are also becoming integral to academic writing by supporting various stages of the writing process (Dilmegani, 2024). For instance, gAI aids in brainstorming by sparking ideas based on key words from prompts, enabling students to further refine the ideas through academic research. Students can also generate outlines for essays and presentations. For those unfamiliar with certain genres of writing, gAIs can produce model texts, such as literature reviews which demonstrate typical components and structures. In summarizing longer texts, gAI can highlight

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key points, helping students orient themselves before a detailed analysis. For refining texts, gAI offers grammatical corrections and style improvements, although students should critically evaluate these to retain their unique voice (UNC-Chapel Hill Writing Center, 2023).

Another example of gAI use in the classroom is the gAI, Gauth (Gauth, 2024). This gAI can solve advanced mathematics questions providing a step-by-step solution. Generative AIs used in the mathematics classroom have the potential to empower students as gAIs levels the playing field for struggling students. This use of gAI is ideal for abstract mathematics concepts rather than foundational concepts that might be better taught using manipulatives or a visual aid such as an instructional video. Unlike gAIs that assist students with writing tasks that are submitted for grading, gAIs developed to solve mathematics questions, still require students to demonstrate their learning on formal assessments in a classroom setting.

Despite its enormous promise in the classroom, gAI's quick implementation has prompted serious debate. Many educational institutions are concerned about its effect on students' ability to learn, the future role of the classroom teacher, and academic integrity (Brookings, 2023; Lonas, 2023). It is also important to note that with the launch of ChatGPT in 2022, the speed of gAIs implementation in higher education has left research in this field trailing this technological innovation. Thus, research on the use of gAI in higher education is essential and timely.

This literature review examines the current literature on gAI in higher education and the extent students have been using these tools. The review is organized into the following themes: Generative AI gains in education, reactions to AI development, gAI use across disciplines, and last, academic integrity and ethical considerations.

Before delving into the literature in each of these sections, it is important to disclose how we used gAI to prepare this literature review. To begin, we employed the Scholar AI app, a

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generative AI tool designed to streamline the process of identifying relevant academic articles (ScholarAI, 2024). This app utilizes advanced algorithms to scan through vast databases of published material, suggesting articles based on keywords, topics, and themes we inputted relevant to our research. As Scholar AI provided initial article suggestions, we carefully verified each recommendation to ensure they were from peer-reviewed journals. This validation process involved checking the articles against recognized academic databases accessible through our university's library portal, which also allowed us to circumvent any access restrictions Scholar AI faced due to authentication and authorization limitations.

Additionally, to complement the AI-generated list and cover any gaps, we directly utilized our university's databases to conduct a more traditional, manual search. This approach ensured a comprehensive coverage of literature, allowing us to access and include papers that might not be readily available or indexed in the databases that Scholar AI scans. By combining the efficiency of generative AI with meticulous human oversight and traditional academic resources, we were able to compile a robust and credible literature review that adheres to academic standards and supports our research objectives.

Generative AI Gains in Education

As previously noted, generative AI has only recently begun to make its way into the classroom. Applications like ChatGPT have demonstrated how these technologies have progressed from simple text recognition to complex language synthesis (Harvard, 2023). This advancement has revealed how far AI has come in its capacity to comprehend and create text that sounds human, subsequently creating more effective and natural uses in educational settings.

Generative AI tools' ability to produce readable and contextually relevant content has expanded opportunities for both students and educators. In a research project conducted by

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Deepika et al. (2023), an AI-driven smart text generator enabled users to input a subject or topic they were interested and the system then generated a smart text document containing relevant information, images, and video links. Could this be a potential replacement for textbooks in higher education, given how the technologies enabling this concept are rapidly improving? These AI tools are not only adaptable to different learning styles, but they also provide interactive experiences that can increase student motivation and engagement in the learning process (Bilad et al., 2023). For example, Yıldız (2023) showed that ChatGPT, as a learning material, increased motivation in language learners, highlighting the potential of conversational AI in education. Findings from another study reported that the application of an AI-based chatbot significantly improved academic performance, self-efficacy, learning attitude, and motivation of 18 students in an experimental group compared to a control group of 20 students who did not use the tools (Lee et al., 2022).

Generative AIs are also being applied in other contexts in educational environments. Studies have shown that generative AIs are useful in academic writing, as they can facilitate research, ideation, and the creation of drafts of a document (Hsu, 2023). Not only can the technology aid non-English native speakers to contribute effectively to academic discourse, as highlighted by Hsu (2023), but also facilitate content creation for courses to provide personalized learning experiences (Tiwari, 2023). One of the most recent examples of personalized tutoring is Khanmigo, an AI-powered teaching assistant from Khan Academy (Meet Khanmigo, 2024). This gAI tool adapts to the individual learning pace and style of each student, aiming to mimic the supportive role of a human tutor by identifying learning gaps and offering tailored exercises to foster a deeper understanding of the material.

Both opportunities and threats may arise from using gAI in the classroom. Generative AI can revolutionize conventional pedagogies by creating new avenues for student learning and

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effective teaching (Kadaruddin, 2023). Alternatively, it raises important questions and concerns about the balance between AI assistance, student autonomy (Trust & Whalen, 2023), and an increasing reliance on AI to learn and complete assignments. In a survey administered by Anthology (2023), a company specializing in educational technology and services, more than half of US students predicted that they would use gAI tools more frequently in the coming months; however, it was not clear whether students understood the impact of increased gAI use on their ability to learn and complete assignments. The study by Anthology highlighted a need for future research to go beyond investigating gAI adoption rates and begin to quantify and analyze specific patterns of generative AI use in higher education as well as studying the extent to which students understand the impact of increased gAI use.

Reactions from Institutions and Educators

As the integration of gAI into higher education evolved, institutions faced profound implications on teaching and learning, which prompted a range of responses. These responses included the development of new policies on gAI use in coursework to ensure academic integrity (Chenjp, 2023; Stanford Generative AI Policy Guidance, 2023), guidance for instructors to navigate the technology (Guidance for the Use of Generative AI, 2023), and addressing equity concerns ensuring all students have access to gAI resources (Cook, 2024). Fewer than 10% of the more than 450 educational institutions surveyed by UNESCO have published official guidelines or institutional rules on the use of generative AI (UNESCO, 2023).

A year after ChatGPT's launch, academic communities began to hone their experiences into recommendations. A compilation of experiences documented in an article by Coffey (2024) provided a valuable snapshot of educators' nuanced perspectives and approaches needed to integrate gAI tools effectively. In summary, they emphasized a balanced approach, calling for

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more gAI literacy and careful integration into teaching and learning. Higher education's role in gAI literacy and preparing students for the workforce is more critical than ever, especially considering findings from a study that demonstrated gAI could boost the productivity of highly skilled workers by as much as 40% when used within its capabilities (Dell'Acqua et al., 2023). Perhaps the timing is right for universities to examine whether students' use of AI is helping them become more productive in completing assignments while also advancing their learning. This information would be an indicator to substantiate the work of Dell'Acqua et al. (2023).

Another example of how institutions of higher education have responded to gAI involved using Bloom's taxonomy (Bloom et al., 1956) to reevaluate course outcomes and student learning (Oregon State University, 2024). By distinguishing how gAI tools can support learning activities and highlight human skills that faculty should emphasize, this approach has the potential to guide the integration of gAI into the curriculum even more thoughtfully, effectively, and efficiently. Similarly, Cornell University's (2024) strategies, among other universities, around gAI use, exemplify the proactive steps institutions are taking to navigate this new landscape. Their strategy centers on adopting gAI via a collaborative, university-wide approach that includes experimental gAI services throughout its campuses with an overall goal of integrating the tools into administration, education, and research (Cornell University, 2024). Similar guidelines have been proposed by UNESCO (2023), however, there is a need for tailored policies that consider the unique context of each institution.

Generative AI Use Across Disciplines

The impact of generative AI in higher education is felt across different disciplines. In the humanities and social sciences, generative AI tools are reshaping research by enabling the analysis of large datasets of historical texts and facilitating a deeper understanding of cultural

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and social dynamics (Karjus, 2023). Educators in this discipline are also exploring gAI to create more interactive and engaging learning experiences. For example, an associate professor experimented with her courses by asking students to compare their narratives to those generated by ChatGPT. Her experiments have led students to recognize the tool's value for brainstorming and ideation, as well as its limitations in replacing the human element in writing (Gunnell & Walker, 2023). In a presentation by a faculty member from an American college, a similar experiment revealed that while students have been better at understanding the limitations and benefits of gAI, most of them were not entirely aware of some of the false data generated by gAI (Eberly Center, 2023).

Generative AI use in Science, Technology, Engineering, and Mathematics (STEM) disciplines cannot be overlooked. In a news article on ways ChatGPT can be used in STEM classrooms, director of Computer Science at an American university highlighted the benefit of gAI in a flipped classroom learning environment (Antoine, 2023). A flipped classroom is an instructional model that allows students to engage with course material outside of class, freeing up class time for more interactive learning (Brame, 2013). Antoine (2023) explained that this approach enabled students to independently develop their understanding of fundamental concepts prior to entering the classroom by allowing them to ask gAI tools an unlimited number of questions. To understand students' interaction with gAI as a tool to engage in thinking, a case study by Vasconcelos and Santos (2023) simulated STEM student learning experience by interacting with gAIs. This study revealed that gAIs could help students think more deeply and creatively, solve problems, and understand ideas better within the STEM disciplines. However, it is important to acknowledge potential limitations and concerns about its accuracy and reliability. Another study conducted to investigate ChatGPT's capabilities in solving physics problems, presented the gAI with 40 carefully chosen problem sets. According to the study's findings,

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ChatGPT solved 62.5% of well-specified problems and only 8.3% of underspecified problems (Wang et al., 2024). In the discipline of chemistry, research has shown the possibility of students using an AI tool for generating lab results rather than engaging in the lab and using AI to advance their depth of thinking (Humphry & Fuller, 2023).

Contrary to beliefs that AI may stifle creativity (De Cremer et al., 2023), gAI has been noted for making strides in the creative arts by providing new tools to design, create music, and create digital art. For instance, a panel discussion at MIT, which included artists and academics explored the impact of gAI on art and design, revealing the unique set of challenges and opportunities it presented to creative professionals (Lemp, 2023). However, this advancement into the arts has also sparked debates about the implications of gAI in the creative industry. Some creatives have expressed concerns about the potential impact on human creativity, particularly in fields such as illustration and commercial art, and raised questions about originality and copyright issues (Clarke, 2022). However, proponents argued that these technologies are not only tools for creation but also for inspiration, enabling students to explore new artistic domains and express their creativity in novel ways (Eapen, 2023), and a call to include pedagogy that addresses the responsible use of gAI (Habib et al., 2024).

Academic Integrity and Ethical Considerations

There is no doubt gAI in higher education, particularly tools like ChatGPT, has brought academic integrity and ethical concerns to the forefront of discourse. In a recent study of 16 academics, they could not identify AI-generated text half the time (Matthews & Volpe, 2023). The ability of AI tools to produce complex, human-like text poses new difficulties for academic integrity, raising questions about authorship and originality. The focus for higher education should be on learning and intellectual growth, not just on completing tasks, which is made more

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difficult when students can easily generate assignments. It is therefore necessary to emphasize clear guidelines on ethical and responsible use, as addressed by one American University (University of Kansas, 2024). Further, it seems pertinent that institutions of higher education need to re-think how they assess student learning (Ogunleye et al., 2024).

It is important to note that the ethical use of gAI extends beyond concerns of plagiarism to encompass data privacy, consent, and the biases inherent in AI-generated content. Williams (2024) discussed how stakeholders need to think about the effects of using gAI tools that were trained on large, possibly biased datasets while stressing comprehensive measures to address these issues. Despite ongoing efforts to address the academic and ethical implications of gAI through policy development and curriculum design, there is still a sizable gap in understanding how academic communities perceive and implement these measures (McDonald, 2024). This gap emphasizes the need for research that not only assesses the effectiveness of existing policies, but also investigates students' and educators' perceptions and behaviors toward gAI use in academic settings, as suggested by Denecke et al. (2023).

This review of literature highlighted how gAI is influencing changes in teaching and learning in higher education. ChatGPT, along with other gAI tools, are revolutionizing student learning. There is still a lot we do not know about the extent students use gAI for their assignments and the perceived long-term impact on learning. The introduction of gAI in higher education is a complicated web of interactions between policy and practices, using AI to support teaching and learning, and re-thinking how we assess student learning in this new age of technology.

Method

Survey

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Given the relative newness of this area of inquiry, we developed our own survey. The survey collected the following demographic information, which also served as grouping variables: gender, faculty/school, undergraduate/graduate status, domestic/international status, and frequency of gAI use (frequent user, occasional user, rare user, not a user). Another descriptive item asked students to identify which gAIs they have used.

The next set of items measured use or intended use of gAIs in completing coursework (15 items). Following were three scales used to measure perceptions about: (a) impact of gAI on learning (18 items) ($\alpha = 0.857$), (b) privacy concerns related to gAI use (9 items) ($\alpha = 0.726$), and ethical considerations related to gAI use (14 items) ($\alpha = 0.790$). In addition, there were two open-response items. The first open-response item specifically asked students to describe how they were using gAI to support their learning and the second item asked students how they thought instructors' assessments should change in light of gAI.

The study was approved by the research ethics board at the researchers' institution. The survey was available online using Qualtrics and in paper format. At least one member of each faculty was solicited to help distribute information about the study.

Data Analysis

Descriptive statistical analysis included frequency and percent. Before the mean and standard deviation were calculated for all scale items, responses of 'Don't Know' were analyzed separately and then changed to missing values to avoid inflating the mean scores; resulting in 5-point response scales anchored from *not useful* to *very useful* and *strongly disagree* to *strongly agree*. Second, an analysis of variance (ANOVA) was used to compare one independent grouping variable with one of the continuous dependent variables. Last, the open response data

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was reviewed, coded, and synthesized to generate themes. The emergent themes were then used to respond to the research questions posed in the study (Saldaña, 2015).

Findings

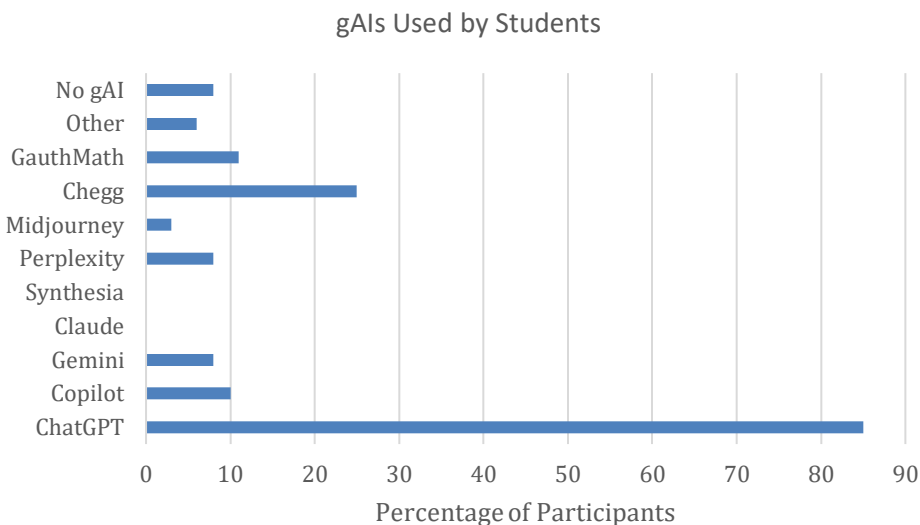
Participant Demographics

The 253 participants were students enrolled in a post-secondary program at a small Canadian university. Sixty percent were female, and the majority were undergraduate (80%) domestic students (60%). Thirty-seven percent of students reported they used gAI at least once a week, 30% used gAI at least once a month, 15% used gAI at least once in the last 6 months, and 12% indicated they did not use gAI. When asked what gAI they were using, the predominant (85%) gAI was ChatGPT which was followed by Chegg (25%), a gAI to help students with homework and includes access to digital textbooks (*Chegg*, 2024) (see Figure 1). Other gAIs were considerably less used than the predominant, ChatGPT. In the category of ‘other’, students indicated they used Grammarly, which was originally launched as a grammar and spell check AI tool and eventually expanded its capabilities to include gAI features (*Grammarly*, 2024).

Figure 1

Percentage of Students Using the Different gAIs

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Descriptive Statistics

Regarding the 15 items that measured use or intended use of gAI to assist with coursework, 20% or more of students responded to each item indicating they did not know whether gAI was useful in the context mentioned in the survey item. This descriptive analysis of the ‘don’t know’ response option suggests there are many students who are either not using gAI for these specific tasks or are not using gAI extensively. Contexts where students felt gAI was useful included using gAI to diagnose an ailment (35.2%), provide practice exam/scenario questions (25%), translate from one language to another (27.2%), and create PowerPoint Presentations (24.0%).

Based on mean scores above 3.5 and a combined percent for responses of 4 or 5 (out of the 5-point scale) that were above 40% of participant responses, the majority of students were using gAI to: provide a summary of a reading task, translate languages, generate ideas for an assignment, teach them about a concept, create an outline for a project, suggest better vocabulary, and improve grammar.

Inferential Findings

Impact of gAI on Learning Scale

The one-way ANOVA was used to compare mean scores on the 5 grouping variables and the scale measuring the impact of gAI on learning. A statistically significant difference at the $p < 0.05$ level was found when comparing the mean perception about gAI's impact on learning score grouped by frequency of gAI use ($M_{\text{Frequent}} = 3.13$, $M_{\text{Occasional}} = 3.14$, $M_{\text{Rare}} = 3.33$, $M_{\text{NotUser}} = 4.03$): [$F_{\text{gAIFreq}}(3,120)=9.197$, $p < 0.001$]. Tukey's post hoc analysis revealed that the most frequent users were statistically significantly different from students who self-identified as a rare or not a gAI user. The effect size of 0.187 was calculated using eta squared, which is considered a large effect, suggesting the statistical significance also has practical significance (Cohen, 1988).

Privacy Awareness Related to gAI Use

An ANOVA was next used to compare the mean scores on the 9-item scale measuring perceptions about privacy awareness related to gAI use, grouped by the five variables. Neither of these analyses was statistically significant.

Ethical Considerations Related to gAI Use

Last, an ANOVA was used to compare the scale measuring ethical concerns related to gAI use and the five grouping variables. There were three statistically significant differences. The first was between the ethical concerns scale and faculty to which students belonged: $F(4, 151) = 3.644$, $p = 0.007$. This statistical significance had a moderate (0.088) effect size. Tukey's post hoc analysis revealed that the significant difference was between students in business ($M_{\text{Business}} = 2.73$) and students in education ($M_{\text{Education}} = 3.43$), where students in education were more ethically concerned about gAI use than students in business. The second significant difference was found in students' status in terms of whether they were registered as a domestic or

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international student: $F(1, 153) = 24.278, p < 0.001$. The difference in mean scores ($M_{\text{domestic}} = 2.92, M_{\text{international}} = 3.42$) was considered large (eta squared = 0.137), where international students were more ethically concerned about gAI use than their counterparts.

The third significant difference was found between students registered in an undergraduate or graduate program: $F(1, 157) = 6.888, p = 0.010$. The difference between the means ($M_{\text{undergrad}} = 3.08, M_{\text{grad}} = 3.44$) was considered a small to medium effect (Cohen, 1988), where students in a graduate program were more ethically concerned about gAI use than undergrad students.

Qualitative Findings

Describe How You are Using gAI to Support Your Learning

The analysis of responses to this item led to seven key themes, listed in order of most to least frequently described gAI use: (a) help with course assignments (checking answers, finding solutions, etc.) (60 responses), (b) help understanding lecture topics (53 responses), (c) generating ideas for assignments and “kick start” writing (51 responses), (d) checking grammar and spelling (34 responses), (e) summarizing or paraphrasing readings (30 responses), (f) find reference information (17 responses), and (g) assist with computer coding (7 responses). There were 23 students who indicated they were not using gAI.

How Should Instructors' Assessments of Student Learning Change

Less than 200 students provided a response to this item and another 15 indicated they did not have a response to this question. The fewer number of responses might possibly be due to the challenge in answering this question which is currently being posed in institutes of higher education (Bower, et al., 2024; Smolansky et al., 2023). The responses to this item varied from being off topic to providing some insightful and practical ideas for assessing student learning in

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an age of gAI. The prevailing theme (24 responses) focused on a return or refocus on in-class assessments such as quizzes, tests, exams, and papers written in-class where student work could be supervised. Students also suggested oral assessments and presentations were viable assessments of student learning in an in-class setting. The second theme had fewer responses (12) but suggested that assessments could involve more critical thinking and problem solving of unique problems, whereby using gAI would not pose a great advantage as the assessment of student work as it would involve original student responses. Related to this theme was a sub-theme that resonated with ideas of assessments that called for original ideas. The last theme drifted from the question in that responses (15) did not describe how the assessment of student learning should change but rather, what instructors needed to do to level the playing field in terms of gAI use. Phrases such as articulating how and when gAI can be used, regulating gAI use, creating a set of rules, and clear/specific/strict guidelines captured students' responses in this theme.

Discussion

This study aimed to investigate the prevalence and modes of gAI use among university students and how demographic variables influence perceptions of gAI's impact on learning, privacy, and ethical concerns. This research adds to the continuing conversation about the impact of technology on education, especially considering the fast-developing gAI tools.

Research Question 1: What gAIs are students in higher education using and how are they using gAI to support their learning?

Findings revealed that a significant proportion of students were utilizing ChatGPT and Chegg as the go to gAI. Gauth was another commonly used gAI for support with mathematics and chemistry questions along with Copilot, which helps with coding.

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Predominantly, these tools were employed to assist with homework assignments, such as checking answers to assigned questions and checking solutions to mathematics and chemistry questions. Using gAI to support homework also included assisting students with writing tasks, whether that be kick starting the writing process, generating ideas for an essay or improving the quality of writing by correcting grammar and spelling errors. Students also reported using gAI, most often ChatGPT, to understand lecture topics more deeply, generate summaries of readings, and brainstorm ideas for assignments. This use reflects a shift in how students are approaching and managing academic tasks. Students also called for more guidelines on how gAI can be used to complete coursework. As students noted, returning to in-class assessment might be the best solution that would allow students to continue to use gAI to support their learning while being assessed for their learning without the aid of gAI.

These findings are consistent with emerging research suggesting gAI tools are becoming more integrated into the student learning experience (Fütterer et al., 2023). However, this study contributes to this body of literature by detailing the specific types of gAIs in use and the breadth of their applications, an aspect less covered in earlier research. Our findings contrast with traditional views that primarily depicted AI as a supplementary learning aid, where in the case of this study, gAI is now playing a more central role in students' learning.

The adoption of gAI tools for academic tasks suggests that these technologies are becoming embedded in the learning process, potentially transforming traditional ways of assimilating information and creating new content. This shift raises important questions about gAI's impact on students' development of critical thinking and problem-solving skills, as reliance on gAIs for routine tasks could diminish these essential competencies. This impact on student learning resonated in student comments regarding how instructors' assessment practices

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should change, if at all, in response to rapid gAI use by students. In this area of inquiry, students called for more in-class assessments where students' competencies are assessed rather than the work of gAIs. In addition, students also called for assignments with critical thinking and problem-solving that would call upon original work rather than the work of gAI. Further research is needed to examine the extent to which gAI can assist with such assignment tasks that calls for high-level thinking.

Summary – Research Question 1

Considering these findings, educators, policymakers, and curriculum designers should consider incorporating gAI literacy into their teaching strategies to ensure that students use these tools effectively and critically. It is also important that students understand the potential impact of overusing gAI on their cognitive development (Cong-Lem et al., 2024). Thus, training should emphasize gAI's strengths and limitations, encouraging students to use these tools to supplement rather than replace learning. Furthermore, policies must strike a balance between using gAIs for educational advancement and upholding high academic standards.

Research Question 2: To what extent does gender, faculty, program (grad/undergrad), status (domestic/international), and frequency of gAI use influence perceptions about the impact of gAI on (a) learning, (b) privacy, and (c) ethical considerations?

(a) Impact of gAI on Learning Scale

When responses were grouped by frequency of gAI use, a statistically significant difference in perceptions of gAI's impact on learning was found. Frequent and occasional users reported greater awareness about the impact of gAI on learning compared to those who rarely or never used gAI tools. This suggests that greater familiarity and regular interaction with gAI may enhance perceptions of its educational value. This finding is corroborated in Chan and Hu's

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(2023) study who reported a positive correlation between knowledge of gAI technology and frequency of use. Given that it is likely to see a rise in the number of gAI users, it is possible that more students will acquire a greater understanding of the positive and negative impact of gAI on learning.

(b) Privacy

The mean score for perceptions towards privacy was compared based on gender, program of study, status (domestic or international), and self-reported frequency of gAI use. Neither of these groups presented a statistically significant difference. Although a significant difference was hypothesized, given the relative newness of gAIs and subsequent absence of gAI guidelines, we looked at the individual items for more interpretation of this finding. One item with a mean score of 3.45 (SD = 1.236) suggests that students may have accepted the lack of privacy protection when using gAI given that it is the same as Facebook and Instagram and students have simply accepted that software collects their information for other uses. Given that gAI is much more powerful than Facebook and Instagram, the investigation into how gAIs use student information and whether that use has any impact on students is worth continuing.

(c) Ethical Considerations Related to gAI Use

Faculty. Significant differences were also observed in perceptions towards ethical concerns related to gAI use. The mean score on this scale was highest for students from the Faculty of Education compared to the lowest mean score from students in the Faculty of Business. There was no other literature examining this relationship. Our interpretation of this finding attributed the difference to students in the Faculty of Education, who may already be weary of the impact gAI has on their teaching in terms of how gAI should be used to support student learning and how learning can be measured in a world absorbed in gAI. In comparison,

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students in the Faculty of Business may be harnessing the potential of gAIs to make their jobs easier, such as using gAIs in marketing to quickly create marketing materials that extend beyond their own creative abilities. Educators (i.e., pre-service teachers) may be bound by ethics of the profession that upholds high academic integrity related to the authenticity of student work whereas business students may be influenced by the product and not the process of how the product was generated. Assuming measuring the authenticity of students' work still matters in this technological age, instructors in the Faculty of Business may need to provide more guidance on what is and what is not acceptable in terms of gAI use.

Program (Undergrad/Grad). Mean scores for the scale measuring ethical concerns were notably higher among those in graduate programs; however, the finding was not statistically significant. It seems reasonable that perceptions of students in the graduate program would have higher mean scores given that many graduate programs involve demonstrating an ability to engage in authentic research, resulting in the creation of new knowledge; thus, it was surprising that this finding was not statistically significant, possibly because there were many more undergraduate students completing the survey than graduate students. Further research is recommended to examine the differences in perceptions towards the impact of gAI on learning at the graduate versus undergraduate level.

Status (domestic/international). A significant difference was found when comparing perceptions towards the impact of gAI on learning and students' status as a domestic or an international student. In regard to interpreting why perceptions of international students towards ethical concerns was higher than domestic students, it is possible they have more at stake than their domestic counterparts. However, given that many international students are second language writers, it seems feasible that they would benefit from gAI tools to support their writing

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and not perceive ethics to be a concern. There was no other research documenting gAI use between domestic and international students; thus, more research is also needed in this area.

Summary – Research Question 2

As anticipated, perceptions towards gAI differed based on different demographic characteristics. In this study, mean perception scores differed based on frequency of gAI use, faculty, program (undergrad/grad), and status (domestic/international). Chan and Hu's (2023) corroborated our findings about differences in perceptions based on frequency of use. Additional research, possibly interviews or focus groups are needed to better understand why perceptions towards gAI use and ethical concerns differ based on faculty, program, and status.

Limitations

Although the sample was sufficient, it represents only students registered at a small Canadian university and our data was self-reported, as with all survey data, which introduces potential biases, including social desirability bias and recall inaccuracies (Durmaz et al., 2020). Last, the rapid pace of improvements and innovations in gAI means that the tools and capabilities available at the time of the study may soon be outdated. This acceleration could affect the relevance and applicability of the findings after the study's completion.

Declaration

The authors report there are not competing interests to declare.

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