Students' Use of GenAI Tools in Undergraduate Software Development Capstones: A Case of Selected Universities in Uganda

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Abstract

The aim of this study was to examine the effective use of generative artificial intelligence (GenAI) tools such as ChatGPT and Gemini, by university students in their final-year projects. This study was carried out at Makerere University Business School and the Islamic University in Uganda, among students enrolled in Information Technology and Computing Sciences-related programmes. The study adopted a quantitative approach using the cross-sectional survey design. Cluster sampling was employed, dividing the target population into two groups (one from a public tertiary institution and another from a private university) and taking random samples from each cluster. Data was collected using a semi-structured questionnaire created using Google Forms and distributed via links to students' social media groups. The data was analysed using SPSS version 20. Results of the study revealed that the majority of students (95%) were aware of the existence and importance of GenAI tools. The study found that perceived benefits, ethical considerations and behavioural intention significantly predicted effective use of GenAI tools in capstone projects. It was concluded that behaviour intention is the strongest predictor of students' effective GenAI use in their software development capstones, followed by perceived benefits and ethical considerations. The researchers recommend that universities and higher education stakeholders make concerted effort to sensitize students about the benefits of GenAI, promote positive behavioural intentions, and encourage ethical use of these tools in research other educational settings.

Keywords: *Behavioural intention; Effective use; Ethical considerations; Generative artificial intelligence; Perceived benefits; Students' research.*

Introduction

The emergence of educational Artificial Intelligence (AI), a subfield encompassing generative artificial intelligence (GenAI) and Large Language Models (LLMs), is ushering in a new era of learning characterised by personalisation, collaboration, and student empowerment. An AI-powered learning assistant could provide step-by-step solutions,

identify common mistakes, and offer alternative solution methods tailored to the student's learning style (Lim et al., 2023). AI can nurture student-led learning initiatives by offering personalised recommendations for learning resources, suggesting relevant research topics, and providing feedback on student projects (Grájeda et al., 2024). For example, a study conducted by von Garrel and Mayer (2023) in Germany involving over 6,300 students revealed that generative AIs are gaining significant traction among learners. The study also highlights the potential of these tools to disrupt traditional learning models and reshape the university landscape by changing how students learn and how instructors teach. Similarly, Yusuf et al. (2024) conducted a study encompassing 1,240 students and lecturers from various tertiary institutions across 76 countries. Their findings indicated widespread adoption of GenAI tools across diverse academic disciplines. While the introduction of AI in education was initially received with ambivalence and fear (Sibanda et al., 2023), its increased importance cannot be over-emphasised, and as such many stakeholders are expressing optimism at the increased AI integration in learning (Lim et al., 2023). AI and LLMs have three major functions in learning: acting as assistants; enabling active student collaboration; and nurturing student-led learning (Grájeda et al., 2024). University students use GenAI tools like ChatGPT, AlphaCode, Google's Gemini, and GitHub Copilot in their research projects to perform a wide range of tasks (Ipek et al., 2023).

The capstone project is an important course in undergraduate engineering and IT programmes. These are terminal courses that provide learners with a combination of hard (technical) and soft (behavioural) skills and competences (Milczarski et al., 2021). These skills include the ability to independently create computer programmes, software and hardware artefacts, troubleshooting programme code, configuring and reconfiguration of hardware tools, working in teams, communication skills, and application of scientific and design thinking principles in their research projects (Kato & van Greunen, 2023). GenAI tools have revolutionised the capstone project in several ways, calling for an urgent need to regulate how students use these tools, and an emphasis on the need for students to organically learn as they are being assisted by these intelligent tools. Singh and Ngai (2024) examined the concerns over academic integrity posed by ChatGPT in higher education (HE) in the top-ranked US and UK universities. Their findings showed that students use ChatGPT to write and support their learning and develop critical research and thinking skills. They also found that misusing ChatGPT threatens academic integrity in the form of academic dishonesty, misconduct, cheating, and plagiarism. This study was general to university teaching and learning and did not address specific study areas, such as use in capstone projects. Liu and Zhang (2024) in their study revealed that students' willingness to use ChatGPT was primarily influenced by the technological revolutions, user experience and cognitive emotions. However, this study did not address the ethical implications of the use of ChatGPT. On the other hand, Fuchs and Aguilos (2023) discussed ChatGPT's perceived usefulness among undergraduate students, noting that most of the participants used LLM to generate initial ideas and received instant feedback. However, the authors noted that in some cases, ChatGPT prompted intentional or unintentional plagiarism among learners. Chan and Zhou (2023) revealed that while students had a positive attitude towards GenAI tools, universities should prepare students for a future where these technologies are prevalent and foster AI ethics in education. It should also be noted that there are limited studies that explore the application of GenAI in students'

research projects in Uganda. The little extant literature relating to GenAI in Uganda has concentrated much on adoption and use in the education sector in general (Namutebi, 2024). Therefore, the purpose of this study was to examine the effective use of GenAI tools in undergraduate software development capstone projects in selected universities in Uganda. The following hypotheses were examined in this study:

H1: There is a positive relationship between perceived benefits and behavioural intention to use GenAI.

H2: There is a positive relationship between behavioural intention and students' effective use of GenAI.

H3: There is a positive relationship between ethical considerations in using GenAI and students' effective use.

Review of Literature

Theory of Planned Behaviour (TPB)

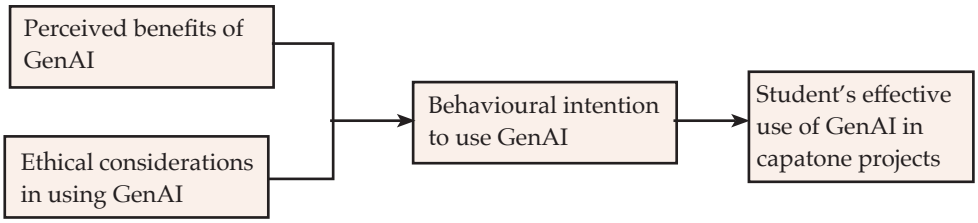
The Theory of Planned Behaviour is a prevalent framework for forecasting purposeful actions. Ajzen (1991) asserts that behavioural intention is influenced by attitudes, subjective standards, and perceived behavioural control. The Theory of Planned Behaviour posits that favourable attitudes towards technology, perceived societal pressure to accept it, and self- efficacy in its effective use enhance the probability of technology adoption. The TPB suggests that academic personnel are more inclined to utilise GenAI tools in research if they recognise their advantages, observe their colleagues employing them, and believe in their ability to incorporate them into their research methodologies (Ajzen, 1991; Ivanov et al., 2024). Through the analysis of factors like perceived behavioural control, attitudes and perceived social impact, the TPB helps elucidate the motivations and reservations regarding the utilisation of GenAI in education settings. While the TPB highlights the key factors that determine intention to use GenAI, it does not sufficiently cater for ethical issues of GenAI use. The Virtue Ethics Theory (VET) was, therefore, incorporated in this study to provide a theoretical foundation for these ethical issues.

The Virtue Ethics Theory (VET)

The Virtue Ethics Theory, as by advanced by Aristotle (350 BC), highlights that the moral quality of an action or situation is best explained by or evaluated based on the character of the actor. The focus of virtue ethics is the moral character, habit and dispositions of an agent (Schlagwein & Willcocks, 2023). Al-Kfairy et al. (2024) apply the VET to GenAI research, pointing out that for GenAI to create meaningful impact in the education sector, stakeholders must advocate for a proactive establishment of policies, guidelines, and frameworks that prioritise ethical virtues like fairness and transparency. This is also highlighted in research by Neubert and Montañez (2020), who indicate that several companies like Microsoft, Tesla, Lucid AI, and IBM have incorporated ethical values like prudence, integrity, temperance, justice, faith (trust), and hope in the design of their AI-driven systems in order to create positive intentions among prospective users. The VET is, therefore, an important framework for analysing ethical issues relating to the adoption and use of GenAI in education and research.

Conceptual Framework

Figure 1: **This conceptual framework was developed after review of literature by Chan and Zhou (2023), and Grájeda et al. (2023)**



Perceived benefits and behavioural intention to use GenAI

Several researchers (Kong et al., 2023; Liu & Zhang, 2024) have identified several benefits of GenAI that are positively related to people's intention to use these tools. Kong et al. (2023) indicate that benefits of GenAI include improved performance, efficiency, and the overall usefulness of these tools facilitates positive intentions to use them. However, this study analysed tutors' perceptions about using GenAI, and students were not considered. Chan and Hu (2023) also observe that benefits of using GenAI, like improved personalised learning, provision of writing and brainstorming assistance, plus research and analysis capabilities were wrongly related to students' willingness to use these tools. These studies generally looked at the use of GenAI by students in their learning, and none of them specifically focused on the aspect of students' research and project development. Basing on this review and analysis, the following hypothesis was proposed:

H1: There is a positive relationship between perceived benefits and behavioural intention to use GenAI.

Behavioural intention and students' effective use of GenAI

Behavioural intention refers to preparedness amongst learners to incorporate GenAI technologies into their educational endeavours (Kanont et al., 2024). Behavioural intention directly predicts the actual use of an information system or what is called use behaviour (Venkatesh et al., 2003). Zhu et al. (2024) revealed that behavioural intention is one of the strongest antecedents of use behaviour. Kanont et al. (2024) also highlight that behavioural intention positively impacts the adoption and effective use of GenAI. However, the study limited itself to using only the TAM model in which behavioural intention relates to actual use, which may not be effective use. This study instead examines how behavioural intention leads to effective use. Ivanov et al. (2024) in their study found that intention to use GenAI positively affected actual use of GenAI. However, this paper's theoretical model is built solely on the TPB in which actual use does not translate into effective use. In light of the evidence presented from previous studies the following hypotheses was proposed:

H2: There is a positive relationship between behavioural intention and students' effective use of GenAI.

Ethical considerations and effective use of GenAI

Perhaps the most discussed themes in the area of adoption and use of GenAI in academic research is the issue of ethics (Resnik & Hosseini, 2025). There are many ethical dilemmas that arise when students use GenAI in their research, like the possibility of plagiarising

content, AI hallucination, fabrication of references, security of data, misuse by students, and generation of factually incorrect information (Hagendorff, 2024). All of these ethical dilemmas may limit effective use of GenAI by students in their research proposals. Blauth et al. (2022), for instance, note that the threat of AI misuse by malicious individuals requires significant and critical emphasis to achieve successful implementation, user and data safety, as well as robust and effective use by individuals. Heigl (2023), on the other hand, indicates that ethical fears, like lack of trust in AI-generated content, may increase user worry, perpetuate ethical biases, and affect people's desire to use these technologies. This has a negative effect on the effective use of GenAI. Stahl and Eke (2024) highlight that applying ethical considerations in GenAI tools like ChatGPT can lead to comprehensive, rigorous and impactful use of these technologies. Basing on this literature, the following hypothesis was proposed for this study:

H3: There is a positive relationship between ethical considerations in using GenAI and students' effective use.

Methods

The study was undertaken at the Faculty of Computing and Informatics, Makerere University Business School (MUBS), and the Faculty of Science, Department of Computer Science and Information Technology at the Islamic University in Uganda, Kampala Campus. This study employed a quantitative approach to produce objective, evidence-based and more straightforward results (Saunders, Lewis, & Thornhil, 2023). The study used a cross-sectional quantitative research design; hence data was collected at a single point in time. The study population for this project were 1,662 students. A sample of 313 students was chosen from this population using the determination criteria recommended by Krejcie and Morgan (1970). Simple random sampling was used to determine the students that participated in the study. The researches obtained a response rate of 57%, which was far above the 45% average rate for online surveys, as indicated by Ceccato et al. (2024). This percentage was sufficient for reliable analysis.

The independent variables were measured using constructs from the TPB (Ajzen, 1991), and students' perceptions of GenAI tools from Gupta et al. (2024) and Dwivedi et al. (2023). Ethical considerations in the use of GenAI were measured using items derived from the research ethics principles like autonomy, non-maleficence, objectiveness, privacy, originality, and fairness, as indicated in research by Stahl and Eke (2020). Behavioural Intention to Use GenAI in Capstone Projects were measured using components from the Unified Theory of Adoption and Use of Technology (UTAUT) by Venkatesh et al. (2003). Students' effective use of Gen AI was measured using dimensions from research by Grájeda (2024).

The questionnaire items were tested for validity and reliability. A copy of the tool was given to four researchers and experts in the area of GenAI, who validated the tool before data collection. The researchers cleaned the tool, removed contextually irrelevant statements, and ensured that the tool measured the research variables appropriately. The Content Validity Index (CVI) was computed in Excel, and all elements were above the 0.7 cut-off recommended by Polit and Beck (2006), and which is widely accepted for establishing adequate content validity in research instruments. To determine the reliability and

internal consistency of the tool, sample data was collected from 15 students and analysed for reliability using the Statistical Package for Social Scientists (SPSS). Cronbach's alpha coefficients were obtained and all of them were above 0.7, as recommended by George and Mallery (2019). Primary data was collected using a structured questionnaire created using a Google Form. The data was cleaned in Microsoft Excel, and exported to SPSS for analysis. The study used a combination of descriptive, inferential, and multivariate statistics to examine the relationships between the independent variables and the dependent variable. Statistical interpretations were made from the SPSS results, and presented using tables.

Research Results

The researchers analysed the data using the descriptive statistics, specifically the mean, interferential statistics, including correlations and regressions, and multivariate analysis, including the Rotated Component Analysis (RCA) and Principal Component Analysis (PCA). The following section includes the analysis, presentation and interpretation of the results from this study. Correlation and regression statistics are shown in the tables in the subsequent sections. These results are based on the research objectives.

a) Perceived benefits of GenAI in capstone projects

We performed descriptive analysis for perceived benefits of GenAI in software development capstones, as indicated in Table 1 below. Mean scores for perceived benefits ranged from 2.402 to 2.894. This implies that most students moderately agreed with the perception that GenAI is beneficial in their capstone projects. Additionally, we performed PCA with Varimax Rotation (VR) to identify the underlying factors associated with perceived benefits of using GenAI in capstone projects.

Table 1: Factor structure of perceived benefits of using GenAI in capstone projects

	Rotated Component Matrix[a]		
Item/Factor		Components	
	Means	Software Development Enhancement	Research Facilitation
GenAI tools are valuable in preparing me for the future of software development by introducing me to cutting-edge technologies.	2.894	0.847	
Using GenAI tools potentially enhances the overall quality of the code I write for my project.	2.519	0.793	
GenAI helped me to develop more innovative software solutions in my final research project.	2.480	0.791	
Using GenAI tools potentially enhanced my critical thinking skills for my research project.	2.592	0.777	
GenAI facilitate a deeper understanding of complex software development concepts by providing clear explanations and examples.	2.865	0.728	
Using GenAI tools potentially enhanced my problem-solving skills for my research project.	2.598	0.693	

Using GenAI helped me improve efficiency of my projects, allowing me to complete tasks quickly.	2.581	0.631	
GenAI tools are beneficial for identifying potential biases in research related to my final year project.	2.586	0.629	
GenAI helped me improve collaboration with peers during the final year project.	2.446	0.613	
GenAI tools helped us in finding relevant research papers about our research topic.	2.402	0.585	
GenAI tools helped me to brainstorm new ideas and sample topics for my capstone project.	2.569		0.831
Generative AI tools provided me background information about our research topic	2.430		0.780
Generative AI tools helped me better understand the study area and our research problem.	2.536		0.739
GenAI tools were a valuable in summarising key points from research papers and documents	2.419		0.679
Eigenvalues		5.565	3.868
Variance (%)		39.749%	27.627%
Cumulative Variance (%)		39.749%	67.37%
	Extraction Method: Principal Component Analysis. Rotation Method: Varimax Rotation with Kaiser Normalisation.		

Table 1 above highlights two distinct components that emerged from the PCA, explaining the clustering of the 14 items based on their factor loadings. These included "Software Development Enhancement" and "Research Facilitation". Results highlight that the statements under the software development enhancement component were generally rated highly and considered valid by respondents. Students, for example, indicated that GenAI tools were valuable in preparing students for future software development by introducing cutting-edge technologies (0.847), enhancing the overall quality of code that students write in their projects (0.793), helping students in developing more innovative software solutions (0.791). Students also linked GenAI tools to enhanced critical thinking during project development (0.777), and assisting learners in solving complex software development problems (0.728). Furthermore, GenAI was linked to improving students' problem-solving skills (0.693), enabling greater efficiency in project completion (0.631), assisting in identifying potential biases in existing research related to the capstone projects (0.629), facilitating collaboration among peers (0.613), and helping students to find relevant research papers about their study topic research (0.629). The second component that emerged, which was "Research Facilitation", was highlighted by the facts that GenAI helped students brainstorm new ideas and topics for their research (0.831), GenAI provide background information on study areas (0.780), GenAI facilitate a deeper understanding of the study area and research problem (0.739), and that it is instrumental in summarising key points from research papers (0.679). These results reveal that the two factors – Software Development Enhancement and Research Facilitation – had eigenvalues greater than 1,

indicating that both factors were meaningful and should be retained. Specifically, the first factor (Software Development Enhancement) had an eigenvalue of 5.565, and the second factor (Research Facilitation) had an eigenvalue of 3.868.

b) Behavioural intention to use GenAI in students' research

Mean scores from descriptive analysis of students' behavioural intentional to use GenAI in capstone projects ranged from 2.769 to 3.649, as indicated in Table 2. This implies that most students were moderately willing to use GenAI in their software development capstone projects. When the researchers performed Rotated Component Matrix Analysis for behavioural intention, only one overarching factor emerged in explaining students' behavioural intention to use generative AI in capstone projects. Therefore, the researchers decided to use Principal Component Matrix (PCM) results for this variable.

Table 2: Factor structure of behavioural intentional to use GenAI in capstone projects

Component Matrix[a]	Mean	Behavioural Intention
I would consider using GenAI tools to help me write code variations to test in my research project.	3.074	0.851
I believe GenAI tools can be a helpful resource for learning latest advancements in software development.	3.244	0.848
I am likely to use GenAI tools to explore different research directions.	3.101	0.824
I am open to using GenAI tools to improve the overall quality of my research project.	3.403	0.824
I believe GenAI tools can be a valuable asset in improving the efficiency of my research process.	3.237	0.823
I expect to use GenAI tools to generate different ideas for new software features in research projects.	3.186	0.820
I plan to continue using GenAI to help me find relevant research papers.	3.000	0.779
I anticipate using GenAI tools to help me understand complex concepts like software development approaches used in my research project.	3.649	0.771
I am interested in using GenAI tools to identify potential research gaps in my chosen study area.	2.769	0.707
Eigenvalues		5.853
Variance (%)		65.029%
Cumulative Variance (%)		65.029%
	Extraction Method: Principal Component Analysis.	
	a. 1 components extracted.	

Table 2 also shows results from Principal Rotated Component Matrix statistics for students' behavioural intention to use GenAI in software development capstones. The respondents also considered the statements corresponding to behavioural intention to use GenAI in software development capstone projects as highly valid. Specifically, this is highlighted in students' agreement with the statements that they would consider using GenAI tools to help them write code variations to test their research project (0.851), that they believed GenAI tools could be helpful resources for learning the latest advancements in software development (0.848), and that they were likely to use GenAI tools to explore different research directions (0.824). In the same light, students indicated that they were open to using GenAI tools to improve the overall research quality (0.824), believed GenAI tools could be valuable assets in improving research process efficiency (0.823), and indicated that they expected to use GenAI tools to generate different ideas for new research projects (0.820). Students also indicated that they planned to continue using GenAI tools to find relevant research papers (0.779), to understand complex software development concepts (0.771), and to identify potential research gaps (0.707). Results from PCA indicate that all the loadings were well above the **0.40** threshold, and most were above **0.70**, which indicates that all items are highly associated with the behavioural intention. This suggests that the factor is both strong and reliable, with all items contributing meaningfully (65.029% variance) in behavioural intention, indicating that the items significantly explained the main variable.

c) Ethical considerations on use of GenAI in capstone projects

Mean scores for students' ethical considerations regarding the use GenAI in capstone projects range from 3.281to 3.859, as indicated in Table 3. This implies that most students were generally aware of ethical concerns regarding the use of GenAI in their software development capstone projects.

Table 3: Factor structure of ethical considerations in using GenAI in capstone projects

Rotated Component Matrix[a]			
Item/Factor		**Component**	
	Mean	**Ethical Awareness**	**Ethical Compliance**
I am concerned that GenAI tools might generate biased responses that could affect research projects.	3.765	0.862	
I am aware that GenAI tools sometimes generate factually inaccurate information that can negatively affect quality of my research projects	3.859	0.833	
I am aware of the possibility of misusing GenAI tools leading to academic dishonesty.	3.824	0.717	
I know that there are certain privacy risks associated with using GenAI tools.	3.747	0.643	

I understand the need to carefully assess the ethical concerns of using GenAI tools for research purposes.	3.699	0.595	
It is important for me to properly cite sources when using information generated by GenAI tools in my research.	3.612	0.594	
I feel confident in my ability to use GenAI tools responsibly and ethically for research.	3.281		0.822
I believe it is important to be transparent about my use of GenAI tools in my research for the final year project.	3.507		0.749
I feel confident in avoiding potential plagiarism issues when using GenAI tools to support my research.	3.469		0.574
Eigenvalues		3.268	2.476
Variance (%)		36.306%	27.512%
Cumulative Variance (%)		36.306%	63.818%
	Extraction Method: Principal Component Analysis. Rotation Method: Varimax Rotation with Kaiser Normalisation.		
	a. Rotation converged in 3 iterations.		

Table 3 above indicates factor analysis results for ethical considerations that students make when using GenAI in capstones. Two factors emerged from the analysis, and these included ethical awareness and ethical compliance. Factor analysis results further indicate that the respondents highly rated statements under ethical considerations in using GenAI. Ethical awareness factors that students rated highly included their concern that GenAI tools might generate biased responses (0.862), awareness that GenAI tools sometimes generate factually inaccurate information (0.833), recognition of the possibility of misusing GenAI tools (0.717), and knowledge about privacy risks of using GenAI tools (0.643). Other ethical awareness issues included the facts that students understood the need to carefully assess GenAI ethics (0.595), and the importance of proper citation and referencing when using GenAI tools (0.594). Three factors relating to ethical compliance emerged. These included students' confidence in their ability to use GenAI responsibly and ethically (0.822), students' belief in the importance of transparent use of GenAI (0.749), and their confidence in avoiding potential plagiarism issues when using GenAI (0.574). Overall, ethical awareness was rated as the more important factor (compared to ethical compliance), with an eigenvalue of 3.268 and a variance of 36.306%. Ethical compliance, on the other hand, had an eigenvalue of 2.476, and contributed a 27.512% to the variance in ethical considerations. Both components contribute a cumulative variance of 63.818%, meaning they are significant factors in students' ethical considerations while using GenAI in their capstone projects.

d) Students' effective use of GenAI tools in capstone projects

Mean scores for students' effective use of generative AI in software development capstones from 2.854 to 3.240, as indicated in Table 4. This implies that most students generally agreed with the fact that using GenAI was important in improving their effectiveness during the software development capstone projects. The researchers also performed Rotated Component Matrix Analysis for effective use of GenAI in software development capstones.

Table 4: Factor structure of effective use GenAI in capstone projects

Component Matrix[a]	Mean	Effective Use
I am confident in using GenAI tools to explore different creative ideas for my software development final year project.	3.139	0.842
I believe I have the skills to use GenAI tools to improve the efficiency of my research process for the final year project.	3.201	0.833
I believe I can easily use GenAI tools to develop a deeper understanding of complex software development concepts.	3.240	0.823
I feel comfortable integrating information obtained from GenAI tools with my final year project.	2.966	0.814
I can easily interpret the outputs generated by AI tools for my research.	3.084	0.810
I am confident in using GenAI tools to identify reliable reference sources and research materials for my research project.	2.854	0.802
I feel confident in my ability to use GenAI tools to enhance the overall quality of the code I write for my final year project.	2.939	0.794
I felt confident about ethically using GenAI tools when writing my final year project report.	2.899	0.785
I can effectively use GenAI tools to identify potential biases in existing research related to my final year project.	3.168	0.764
I can easily choose the most appropriate GenAI tool for my research needs in the final year project.	2.978	0.763
I feel comfortable evaluating the relevance of information generated by AI tools for my software development research.	3.061	0.760
I can easily evaluate the accuracy of information generated by AI tools for my software development research.	3.028	0.728
Eigenvalues		7.561
Variance (%)		63.008%
Cumulative Variance (%)		63.008%
	Extraction Method: Principal Component Analysis.	
	a. 1 components extracted.	

The results in Table 4 show factor analysis results for students' effective use of GenAI in capstones. These results indicate that only one overarching factor emerged in explaining students' effective use of GenAI in capstone projects. All items have returned high factor

loadings (ranging from 0.728 to 0.842), indicating strong associations with the extracted component. These results suggest that each item strongly represents the underlying factor and that students generally feel that they are effectively using GenAI tools in their capstone projects. Specifically, students indicated that they were confident in using GenAI tools in research projects (0.842), expressed the belief that they had the skills to efficiently use GenAI (0.833), and that they were able to use GenAI tools to understand complex software development concepts (0.823), and asserted that they felt comfortable about integrating information obtained from GenAI tools into their projects (0.814). Similarly, students indicated that they could easily interpret GenAI outputs (0.810), confidently identify research materials when using GenAI (0.802), use GenAI tools to enhance the overall program code quality (0.794), and ethically use GeneAI in report writing (0.785). Students also indicated that they could effectively use GenAI tools to identify potential research biases (0.764), could easily choose the most appropriate GenAI tool for research (0.763), could easily evaluate the relevance of GenAI-generated information (0.760), and could easily evaluate the accuracy of information generated by AI tools (0.728). All these factors contributed a 63.008% variance, indicating that they significantly explained effective use of GenAI tools.

Correlation results for perceived benefits, ethical considerations, behavioural intention and effective use of GenAI

We used Pearson's correlation coefficient in SPSS to analyse the relationships between perceived benefits, ethical considerations, behavioural intention, and effective use of GenAI by students in their capstone projects. These results relate to hypotheses 1, 2, and 3, as shown in Table 5 below:

Table 5: Correlation Results

Variables	1	2	3	4
Perceived Benefits of GenAI (1)	1			
Ethical Considerations (2)	0.206**	1		
	0.007			
Behavioural Intention (3)	0.492**	0.374**	1	
	0.000	0.000		
Effective Use of GenAI (4)	0.507**	0.413**	0.750**	1
	0.000	0.000	0.000	

As Table 5 indicates, the correlation results from the study show a positive significant correlation between behavioural intention and effective use of GenAI ($r = 0.750^{**}$, $P = 0.000 < 0.05$). This implies that higher behavioural intention to use GenAI effectively is strongly associated with higher actual use. These results indicate that students who have a strong intention to use GenAI are very likely to use it effectively in their capstone projects. The results further reveal a positive significant but correlation between perceived benefits and behavioural intention to use GenAI ($r = 492^{**}$, $P < 0.05$). These results imply that higher perceived benefits are associated with higher levels of effective use of GenAI. Results from this study indicated a significant positive correlation between ethical consideration

and behavioural intention (r= 0.374**, P = < 0.05). This suggests that stronger perceptions of ethics are moderately associated with student's behavioural intention to use GenAI effectively. The results also indicated a positive and significant relationship between perceived benefits of GenAI and effective use of GenAI (r= 0.507**, P = < 0.05). This implies that when students expect to attain advantage through using GenAI in their capstones, they are more likely to use these technologies more effectively. The correlation results further indicate a positive and significant relationship between ethical considerations and effective use of GenAI in capstone projects (r= .413**, P = < 0.05). These results from the correlation statistics confirmed hypotheses 1, 2, and 3 of this study.

Regression results for perceived benefits, ethical considerations, behavioural intention and effective use of GenAI

The researchers performed multiple regression analysis to determine the extent to which perceived benefits of GenAI, ethical considerations, and behavioural intention determined effective use of GenAI in capstone projects. These results are shown in Table 6 below:

Table 6: Regression Statistics

	Standardised Coefficients	Significance
Effective Use of GenAI	Beta (β)	p
Perceived Benefits of GenAI	0.164	0.004
Behavioural Intention	0.610	0.000
Ethical Consideration	0.169	0.002
Adjusted $R^2 = 0.606$ $F = 84.914$, $p = 0.000$		

The regression results in Table 6 indicate an adjusted R-squared value of .613. This implies that approximately 61.3% of the variance in effective use of GenAI is explained by the predictors (behavioural intention, ethical consideration, and perceived benefits). The ANOVA test found that the variables were statistically significant ($p < 0.05$), indicating that at least one of the predictors (behavioural intention, ethical consideration, perceived benefits) has a significant effect on effective use. Behavioural intention had the highest standardised coefficient (β =.610), and was, therefore, the most important predictor of effective use of GenAI in capstone projects followed by ethical consideration (β =.169).

Regression analysis further supported Hypotheses 1, showing a significant positive association between the perceived benefits of GenAI tools and students' behavioural intention ($p = 0.004$), suggesting that the perceived benefits influence their intention to integrate these tools. Hypothesis 2 was also confirmed, revealing a significant positive relationship between students' behavioural intention and effective use of GenAI tools ($p < 0.000$). This indicates that increased behavioural intention enhances the effective use of GenAI tools in student projects. Hypothesis 3 demonstrated a significant positive relationship between ethical consideration and effective use of GenAI ($p = 0.002$), emphasising that ethical aspects affect students' effective use GenAI. The multiple regression model explained 61.3% of the variance in effective use (adjusted $R^2 = 0.613$), and ANOVA results ($F = 84.914$, $p < 0.001$) confirmed that perceived benefits, ethical consideration, and behavioural intention collectively contribute to effective use.

Discussion of Results

The relationship between perceived benefits and behavioural intention to use GenAI

This study analysed the benefits of generative artificial intelligence and how they are related to students' behavioural intention to use these tools in their research projects. Correlation results from the study also found a positive but moderate association between perceived benefits and behavioural intention to use GenAI in research projects. These results are in line with earlier findings by Grájeda et al. (2024) that integrating AI in education, research and learning is of significant benefit in improving students' level of understanding, creativity, and productivity, and that these advantages further promote the effective use of GenAI by students. The results regarding the perceived benefits or advantages of using GenAI in research also re-echoed earlier findings by Chan (2023), who specifically studied Chinese students. Results from this study suggest that students who had recognised the potential benefits of GenAI tools expressed positive intentions to use GenAI in research.

The relationship between behavioural intention and students' effective use of GenAI

This study further found a strong positive correlation between behavioural intention and effective use of GenAI. This was also confirmed by regression results, which showed that behavioural intention was the most important predictor of effective use of GenAI in capstone projects. These results are in agreement with Ivanov et al.'s (2024) observation that the perceived strengths and advantages of GenAI technologies have a significant and positive impact on their attitudes, and on the actual use of GenAI. These results are reflective of earlier results by several authors like Deschenes and McMahon (2024) and Chan (2023), who indicate that a high number of students in higher institutions of learning have expressed positive intentions towards GenAI, and are actively using these tools in learning and research. Deschenes and McMahon (2024) also indicate that 65% of the respondents studied had used or planned to use GenAI for academic work. These high numbers and their apparent positive attitude towards generative AI facilitate their effective use of the tools in research projects.

The relationship between ethical considerations and students' effective use of GenAI

This study found a positive relationship between ethical considerations and effective use of GenAI in students' capstone projects. These results are in line with the views of Wood and Moss (2024), who indicate that as students appreciate the ethical issues relating to GenAI, their level of comfort in using these technologies for learning and personal growth increases. However, this study uses a small cohort sample to analyse the ethical issues in using GenAI. A more representative sample and a cross-sectional design may be necessary to analyse the study variables more comprehensively. Ning et al. (2024) also developed a checklist for ethical issues that health professionals can consider when using GenAI. The authors add that these increase the responsible use of GenAI by both professionals and medical students. Uligh et al. (2024) also indicate that making students more cognisant of ethical considerations related to GenAI, like the need to validate outputs from Gen AI

tools to remove AI hallucinations and fabricated references, can tremendously increase students' responsible use of GenAI and build their confidence during the learning process.

Conclusions

This study found a positive relationship between perceived benefits and behavioural intention to use GenAI. This implies that when students recognise the value and utility of GenAI in their learning, such as its ability to enhance their creativity and problem-solving, they are more motivated to adopt and use it. Therefore, higher institutions of education and educators who wish to encourage effective use of GenAI in students' learning should sensitise students to the benefits of GenAI through training, workshops, demonstrations, and gradual integration into learning activities. This study further found a strong positive correlation between behavioural intention and effective use of GenAI. These results suggest that students who are motivated and willing to use these technologies are more likely to actually use them effectively. This underscores the importance of cultivating positive intentions towards GenAI usage, through training, awareness campaigns, and supportive programmes and education policies that build meaningful engagement with GenAI among learners. These results also indicated a positive but moderate relationship between ethical considerations and the effective use of GenAI in capstone projects. These results highlight the fact that when students consider ethical issues more seriously, they are more likely to effectively use GenAI in their academic projects. Higher education institutions should, therefore, intensity efforts of creating more awareness and recognition of ethical issues of GenAI, to ensure effective use among learners. Behavioural intention emerged as the most crucial predictor of effective GenAI use, mediating the effects of both perceived benefits and ethical considerations. These results imply that perceived benefits, ethical considerations and behavioural intention are critical factors in ensuring effective use of GenAI among students in their capstone projects. The results of this study specifically underline the importance of enhancing behavioural intention as a key issue in ensuring students' effective use of GenAI, as it influences how perceived benefits and ethics impact usage.

Recommendations

Higher education institutions and policymakers should establish strategies that help students appreciate the benefits of GenAI, and the ethical issues around these tools, as a way of nurturing positive intentions to use these tools in their research. These can include training and more sensitisation to the likely benefits of using these tools and the ethical issues they must pay attention to during their research projects. Furthermore, the researchers recommend that stakeholders in the higher education sector, such as academic staff, university administrators and government, should invest in sensitising students to the key ethical issues that come with using generative AI, like plagiarism and threats to privacy and creativity, as a way of encouraging ethical use of these tools among students, positive intentions to use, and, ultimately, effective use of these tools in students' research projects. Universities also need to establish supportive environments for AI experimentation, promoting cross-disciplinary applications of GenAI, and encouraging

positive attitudes and norms that would ignite a higher behavioural intention towards the use of these tools. Higher education institutions may also need to undertake curriculum redesign and empowerment of learners and instructors through exploring innovative uses of GenAI, ensuring its responsible integration. Comprehensive AI Ethical Use Guidelines must also be developed by universities to ensure that ethics are integral to their application in research and educational settings in general.

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