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Exploring the Impact of AI Tools on Student Learning Through Text Mining

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Abstract. This study addresses the research gap regarding the impact of AI tools on student learning, recognizing their increasing role in educational settings and the potential implications for learning outcomes. The objective was to evaluate students' perceptions and the effectiveness of AI tools in enhancing their learning experiences. A descriptive research design was employed, utilizing an online survey to collect data from 251 4th-year undergraduate students and applying text mining techniques for frequency and text mining analysis. Due to their significant presence in academic activities, the study focused on the five most commonly used AI tools - Quillbot, ChatGPT, Grammarly, Quizizz, and Brainly. Findings revealed predominantly positive sentiments (82.87%) regarding AI's role in improving writing, problem-solving, and information-processing skills, alongside concerns about over-dependence on AI and its impact on critical thinking. The results emphasize the importance of fostering a balanced use of AI tools and promoting AI literacy among students. Educators are encouraged to carefully incorporate these resources to improve instruction while fostering fundamental human abilities, guaranteeing the overall growth of their students.

Keywords: Artificial Intelligence; Educational technology; Sentiment analysis; Student learning; Text mining.

1.0 Introduction

Artificial intelligence (AI) is revolutionizing education, reshaping traditional teaching and learning paradigms with unprecedented speed. From AI-powered writing assistants to adaptive learning platforms, these technologies promise to enhance learning outcomes but also raise critical questions about their impact on students. This study explores these transformative processes, specifically looking at how AI applications affect students' learning. Despite growing adoption, research on AI's impact often overlooks student perceptions, a crucial lens for understanding how these tools integrate into real-world academic settings. Previous studies have highlighted the potential benefits of AI, such as personalized learning and improved efficiency (Ayanwale & Ndlovu, 2024; Greene, 2023; Gocen & Aydemir, 2021; Perez, 2023; Slimi, 2023; Team Capacity, 2021), as well as concerns like dependency and diminished critical thinking (Adlawan, 2024; Santiago et al., 2023). However, gaps remain in exploring how students, particularly those nearing the completion of their undergraduate programs, perceive and utilize AI tools in their academic journey. This study seeks to fill that gap by focusing on 4th year undergraduate

students at Cavite State University-Silang Campus, a population well-positioned to provide insights due to their extensive exposure to AI tools throughout their studies.

The purpose of this research is to evaluate the perceptions and effectiveness of AI tools in supporting student learning. By analyzing the experiences of these students, this study aims to provide insights for educators and policymakers. The findings are particularly relevant in an era where educational practices are entwined with technology, necessitating a balanced approach that takes advantage of AI's benefits while addressing its potential drawbacks. This paper contributes to the field by highlighting both the opportunities and challenges of AI integration in education. It emphasizes the importance of thoughtful implementation strategies that promote AI literacy and foster essential human skills like critical thinking and problem-solving, ultimately ensuring that AI supports holistic student development.

2.0 Methodology

2.1 Research Design

This study employed a descriptive research design, which aims to systematically describe the usage patterns and perceived impacts of AI tools on student learning. Creswell and Creswell (2018) defines descriptive research design as a type of research that systematically collects and analyzes data to provide an accurate portrayal of characteristics, behaviors, or phenomena within a specific population or context. Using an online survey, data were collected from 251 4th-year undergraduate students to identify the most frequently used AI tools and their specific applications in academic activities. Text mining techniques, including frequency and sentiment analysis, were applied to the open-ended survey responses to further illustrate student perceptions and attitudes. These use natural language processing to draw insightful conclusions from unstructured text (Sandu et al., 2024).

2.2 Research Participants

The study focused on a population: 4th-year undergraduate students at Cavite State University-Silang Campus enrolled during the second semester of the 2023-2024 academic year. This choice was driven by the researchers' interest in understanding the experiences of students nearing the end of their undergraduate studies, who are likely to have had more exposure to AI tools in academic settings. A stratified random sampling technique was implemented to ensure representation from various academic disciplines. The student population was divided into strata based on their academic programs, and a proportional sampling approach was applied to determine the sample size for each stratum. Table 1 details the total population and adjusted sampling population for each course. This sampling strategy aimed to provide a balanced representation of students from different academic backgrounds, enhancing the generalizability of the findings.

Table 1. Population and sampling

Course (Stratum)	Population	Sample
Information Technology	135	40
Computer Science	72	22
Business Management	199	60
Hospitality Management	93	28
Tourism Management	83	25
Psychology	121	36
Early Childhood Education	24	7
Secondary Education	109	33
Total	**836**	**251**

2.3 Research Gathering Procedure

An online questionnaire was developed using Google Forms to collect data from the selected participants. The questionnaire comprised five key questions:

1. What are the AI tools that you usually use for learning?
2. How do you use AI tools in terms of learning?
3. What are the benefits of using AI applications for student learning?
4. What are the drawbacks of using AI applications for student learning?
5. How effective do AI tools support your learning process?

Questions 1 and 2 were designed to gather quantitative data on AI tool usage and application. The multiple-choice format allowed for efficient data collection and analysis. Questions 3, 4, and 5 were open-ended, prompting students to provide detailed, qualitative responses regarding their perceptions of AI's impact on learning. This approach aimed to capture student experiences. The survey was administered online through Google Forms, allowing for convenient and anonymous participation. Data collection took place between March 25 and May 17, 2024.

2.4. Text Mining Analysis

The collected survey responses, specifically the open-ended responses to Questions 3, 4, and 5, underwent a rigorous preprocessing stage to prepare the data for text mining analysis. This involved several steps: removal of irrelevant characters, removal of unnecessary spaces, lowercase conversion, stop word removal, and lemmatization. Word frequency analysis was applied to Questions 3 and 4, focusing on identifying the most frequently occurring words in student responses regarding AI tools' perceived benefits and drawbacks in learning. Word frequency counts provided insights into the dominant themes and concerns (Simatupang et al., 2024) expressed by students. The results were visualized using word clouds to enhance interpretation.

The sentiment analysis technique was employed to analyze the sentiment expressed in student responses to Question 5, which inquired about the perceived effectiveness of AI tools in supporting their learning process. Sentiment analysis aimed to classify student opinions into positive, negative, or neutral categories. A lexicon-based approach, considering valence shifters, was used to assign sentiment scores to each response (Dervenis, 2024). The results were visualized using a table, showing the overall sentiment distribution.

2.5 Ethical Considerations

Ethical considerations, including voluntary participation, confidentiality, and data privacy, were emphasized throughout the data collection process. The researchers ensured that participants were informed about the study's purpose, data usage, and their right to withdraw at any time.

3.0 Results and Discussion

3.1 Dominant AI Tools and Their Applications

Figure 1 shows the top five AI tools used by students. The study identified Quillbot as the most frequently used AI tool, selected by 187 out of 251 respondents, followed by ChatGPT, Grammarly, Quizizz, and Brainly. This trend aligns with findings by Marzuki et al. (2023), which highlighted the growing reliance on AI-powered writing assistance tools among students. Quillbot's paraphrasing and grammar correction features are particularly valued, supporting students in producing polished academic outputs. Similarly, the versatility of ChatGPT as a conversational AI tool has been noted in previous studies (Greene, 2023; Santiago et al., 2023), where its capacity to deliver individualized responses improves research and learning.

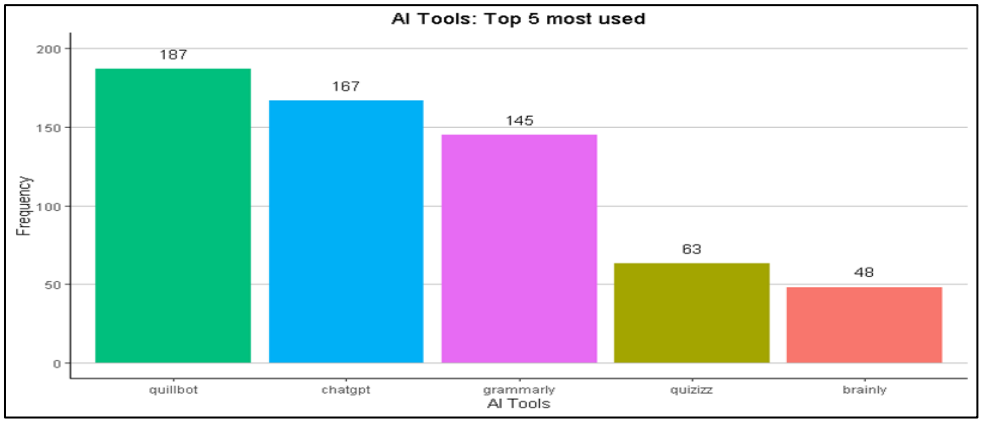

Figure 1. Bar plot of top 5 AI tools students use for learning

Figure 2 reveals that the most frequently selected purposes for using AI tools were "Writing and editing Assistance," followed by "Studying Assistance" and "Information Research Gathering." These findings highlight

AI's essential role in streamlining academic activities and increasing student engagement, as reported in similar studies (Ayanwale & Ndlovu, 2024; Gocen & Aydemir, 2020).

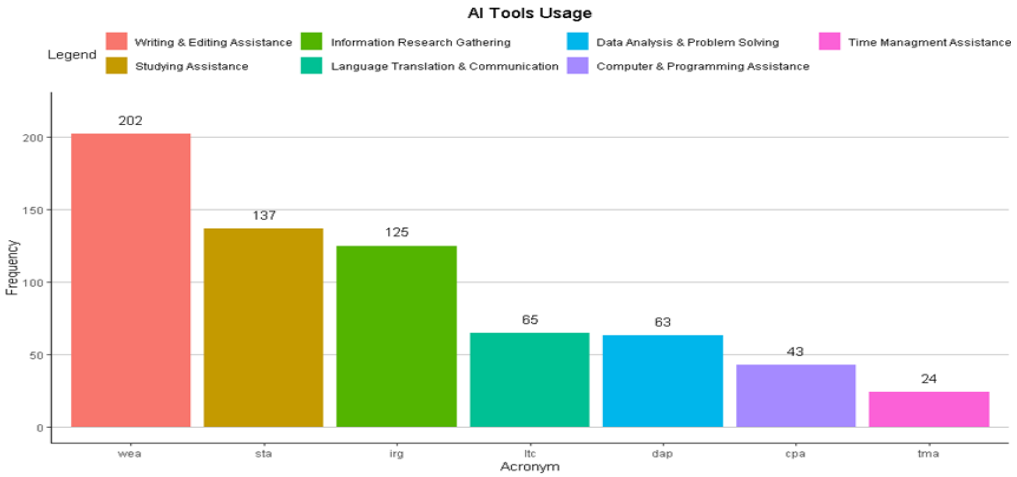

Figure 2. Bar plot showing the different ways students use AI tools for learning

3.2 Perceived Benefits: Efficiency, Accessibility, and Personalized Learning

The analysis of open-ended responses regarding the benefits of AI applications in student learning revealed several recurring themes. The word cloud in Figure 3 visually represents these benefits.

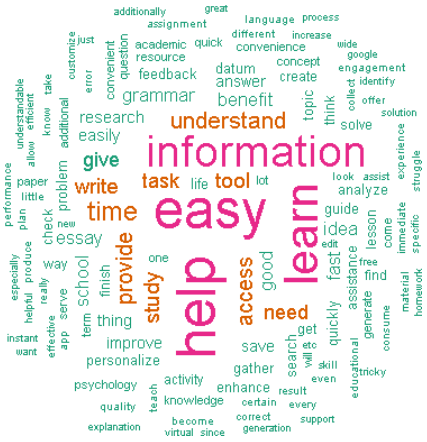

Figure 3. Word cloud visualization of AI applications' benefits to student learning

The word "easy" appeared most frequently (81 times), indicating that students appreciate the user-friendliness and efficiency of AI tools. This suggests that these tools effectively reduce the cognitive load associated with certain academic tasks, allowing students to focus on higher-order thinking and problem-solving. This is consistent with the findings of Ayanwale and Ndlovu (2024), who noted that the accessibility of AI fosters greater student engagement. Responses also emphasized the potential of AI to personalize the learning experience by providing customized feedback, adaptive learning pathways, and access to diverse resources. This suggests that students recognize the value of AI in catering to individual learning needs and promoting greater accessibility to educational content. The emphasis on personalized learning affirms Gocen and Aydemir's (2021) work, which emphasized AI's role in adaptive learning and feedback systems. These benefits indicate that AI applications are supplementary tools integral to modern educational practices.

3.3 Perceived Drawbacks: Concerns About Dependency and Critical Thinking

While students acknowledged the numerous benefits of AI applications, their responses also revealed concerns regarding potential drawbacks. The word cloud in Figure 4 visually represents these drawbacks.

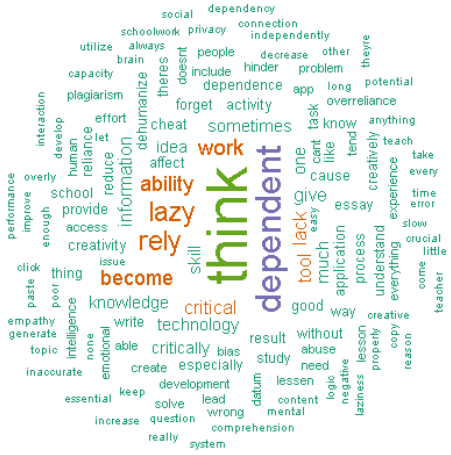

Figure 4. Word cloud visualization of AI applications' drawbacks to student learning

The most frequently mentioned drawback was the potential for students to become overly dependent on AI tools, leading to a decline in their critical thinking and problem-solving abilities. This concern reflects a broader debate about the ethical implications of AI in education and the importance of ensuring that these tools do not replace essential human skills and cognitive processes. While the majority expressed positive sentiments, concerns about over-reliance on AI and its potential to weaken critical thinking were significant. This finding resonates with Slimi (2023), who argued that excessive AI dependence could diminish students' problem-solving skills. Similarly, Perez (2023) noted that while AI aids in streamlining tasks, it risks discouraging independent intellectual effort. Addressing these drawbacks requires educators to integrate AI in ways that complement, rather than replace, active learning strategies.

3.4 Sentiment Analysis of Students' Perception of the effectiveness of using AI Applications to Learning

Table 2 shows the sample responses of students on the effectiveness of AI applications to learning, classified accordingly based on their calculated sentiment score.

Table 2. Student sentiments per polarity

Polarity	Percentage	Sample Response	Sentiment Score
Positive	82.87	"AI tools have greatly supported my learning process by providing personalized experiences, instant feedback, access to diverse resources, and assistance with complex tasks."	+0.70
Negative	8.76	"Pretty much but in moderation as nowadays it makes the person, specifically the student, lazy."	-0.37
Neutral	8.37	"It gives knowledge, but it makes you realize that you don't need to depend on AI."	+0.16

Despite the acknowledged drawbacks, the overall sentiment towards the effectiveness of AI tools in supporting student learning was overwhelmingly positive. Sentiment analysis of the responses to Question 5 revealed that 82.87% expressed positive views, while only 8.76% expressed negative sentiments. This finding suggests that while concerns about potential negative impacts exist, students generally perceive AI applications as valuable assets in their learning journey. Similar findings were reported by Ofosu-Ampong et al. (2023) and Almasri (2024), who highlighted that most students appreciate the convenience and benefits of AI in education, viewing it as a positive tool for enhancing learning experiences. However, a smaller portion remains cautious, raising concerns about its potential impact on education quality and ethical practices. This highlights the need to address these reservations while maximizing the positive contributions of AI to the educational landscape.

4.0 Conclusion

The study confirms that AI is no longer a futuristic concept but a tangible reality for today's students. A significant majority of respondents (specifically, 187 out of 251) identified Quillbot as their primary AI tool, emphasizing the widespread adoption of AI writing assistance. ChatGPT's emergence as a versatile tool for various academic tasks, chosen by 167 respondents, further underscores this trend. These findings and the student's primary use of AI for writing and information gathering reveal how students approach academic tasks - a shift facilitated by AI's ability to streamline and enhance these processes.

While the efficiency and accessibility offered by AI tools are undeniable, student perceptions reveal a balanced perspective. While 82.87% expressed positive sentiment towards AI's effectiveness in learning, a significant portion also acknowledged potential drawbacks. Concerns regarding over-dependence and potential negative impacts on critical thinking highlight the need for a cautious and strategic approach to AI integration in education. The study's findings emphasize the importance of a pedagogical approach that balances AI's capabilities with developing essential human skills. It is crucial to leverage AI as a tool for empowerment, encouraging students to use it to enhance their learning while fostering critical thinking, problem-solving, and intellectual independence.

The key takeaway from this study is the need for a thoughtful and balanced approach to AI in education. This entails equipping students with the knowledge and skills to use AI tools effectively and ethically while fostering a learning environment that promotes critical thinking, creativity, and a deep understanding of the subject matter. By embracing this balanced perspective, educators can harness AI's transformative potential to create a more engaging, personalized, and effective learning experience for all students.

5.0 Contributions of Authors

Gwen Lei Irish P. Maala – drafting, editing, writing, data analysis, Laika Melanie D. Montoya – data analysis, encoding, writing, editing; Feliz Nicole L. Pampan – writing, editing, encoding; Erwin L. Cahapin – supervising, editing; Eleandro C. Anciro – supervising, editing; Beverly A. Malabag – supervising, editing

6.0 Funding

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7.0 Conflict of Interests

The authors declare no conflict of interest.

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