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Utilization of Writing Assistance Tools in Research in Selected Higher Learning Institutions in the Philippines: A Text Mining Analysis

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Abstract. The rise of artificial intelligence (AI) in higher education has sparked significant interest. Artificial intelligence offers opportunities for global learning, personalized instruction, and efficient resource management. In research writing, AI tools streamline processes, from a literature review to data analysis, enhancing efficiency and freeing up

time for critical thinking. The researchers of this study used text mining techniques to extract patterns and trends of using writing assistance tools in research from the responses of 327 faculty researchers in various higher learning institutions in the Philippines. Unigram tokenization was used to present the 10 most frequently used words in the corpus, while the k-means elbow method was utilized to show the optimal number of clusters. Sentiment analysis was use to show the positive and negative implications of using writing assistance tools in research. The finding is that faculty respondents value writing assistance tools for enhancing research writing by expediting processes and improving clarity. The implementation of these tools in selected higher learning institutions may present difficulties, such as issues related to overreliance, and hinder students' and researchers' development of critical thinking and writing skills. Along with technological and resource challenges, these tools could inadvertently encourage plagiarism if not used responsibly. Cultural and language considerations are also relevant because these tools may not always be attuned to the specific linguistic and cultural nuances of Filipino academic writing. The results of this research may serve as a guide for researchers, educators, and software developers, who may use AI to streamline research writing processes in the educational sector.

Keywords: generative writing; research assistance tools; higher learning institutions; text mining; AI

1. Background of the Study

In recent years, there has been extensive interest from the public, government, and academia in the transformative potential of artificial intelligence (AI) and robots. This interest extends to various sectors of society, including higher education (HE), where the impact of AI and robots is expected to be significant and far-reaching (Bates et al., 2020). The use of AI in education has created new opportunities (e.g., global learning, personalized instruction, and efficient resource management) and enables online access to course materials (Chen et al., 2020). Moreover, the pursuit of enhancing the quality and efficiency of scholarly work in research writing is an ongoing process. In this quest, AI technologies have emerged as a promising solution. AI, a branch of computer science, encompasses a range of techniques that enable machines to replicate human intelligence (Jarrah et al., 2023), including natural language processing (NLP) and text mining. These advancements offer new avenues for improving research writing processes.
Massive advances have been made in AI technology-based support for writing research papers. Surprisingly, AI that can generate drafts of an introduction have been developed, and it is now possible to have an abstract automatically created to a large extent (Transformer et al., 2022).

AI integration in research writing holds a significant promise for transforming how faculty researchers approach their work. Artificial intelligence technologies can assist in streamlining various stages of the research writing process, such as a literature review, data analysis, and manuscript preparation. Through leveraging AI algorithms, researchers can efficiently extract relevant information from vast amounts of literature, provide comprehensive summaries, and aid in the

identification of knowledge gaps. Moreover, AI-powered tools can automate data analysis, enabling researchers to handle large datasets efficiently and uncover hidden patterns. By automating routine tasks, AI can free up valuable time for faculty researchers (Kooli, 2023), allowing them to focus on critical thinking, analysis, and knowledge synthesis.

University research institutions around the world are facing concerns regarding the impact of artificial intelligence on academic integrity. For instance, Dehouche (2021) expressed concerns about the potential use of large language models to encourage scientific misconduct and advocated for an urgent change of publishing standards. Wilder et al. (2021) proposed that the responsibility of using AI and dealing with the effects should involve several stakeholders (e.g., AI developers, researchers, policymakers, etc.) because AI technologies have the potential to shape economies, societies, and individual lives in profound ways. Funding organizations involved in academic research are actively exploring the transformative potential of AI and its application in various aspects of research, such as new methodologies, processes, management, and evaluation (Cyranoki, 2019; Chubb et al., 2022).

The impact of AI on research and research policy are still relatively unexplored (Chubb et al., 2022). However, it is also recognized that the integration of AI may disrupt researchers and institutions, presenting significant challenges which can be academic, ethical, and legal (Abdous, 2023). The increasing focus on AI provides an opportunity for empirical research to investigate the opportunities and obstacles faced by researchers who are essential in the advancement and practical implementation of AI for the betterment of society.

By highlighting the potential of AI in improving research writing among academic institutions in the Philippines, this study aims to be an addition to the corpus of existing information. The paper offers evidence-based insights that help the creation and application of AI-powered tools and procedures in the academic setting by probing the experiences and behaviors of faculty-researchers in selected higher learning institutions.

2. Literature Review

2.1 AI-Powered Writing Tools in the Modern Era of Writing Assistance

AI has become increasingly popular in recent years (Hu, 2023) and has attracted much attention from various communities, such as the government, industry, and academia; this calls the need for collaborative efforts to harness its benefits while addressing associated challenges.

The application of AI in writing through writing assistive tools has revolutionized the writing process, one of which is by providing grammar, syntax, and style suggestions (Owan et al., 2023). These tools make use of machine learning algorithms and NLP to suggest or correct grammar, tone, and style. Also, AI writing assistance tools offer immense advantages, such as assisting with content generation, where AI can automatically generate content based on user input or prompts, such as text summaries and the drafting of an entire article (Brown et

al., 2020). These inputs can assist users in finishing sentences that they began but did not complete (Calderwood et al., 2020), and they can even provide ideas and inspirations for creative writing (Clark et al., 2018).

Although AI can be a prodigious resource for creating ideas and finishing sentences, it should be used as a supplement to human creativity rather than as a replacement. Creative writing, in particular, frequently necessitates a human element, emotional depth, and unique perspectives that AI may fail to portray.

AI writing tools are beneficial for checking grammar and spelling (Godwin-Jones, 2022; McCarthy et al., 2019). They are most effective when used as a supplement to human oversight and judgment since they can detect many errors (Coenen et al., 2021) but they may not always grasp the subtleties of context and writing style. Using them for language translation can help writers create multilingual contents in a few hours (Hassan et al., 2018). This saves writers time and effort by avoiding the need to translate. Moreover, these tools can generate content in little time and effort based on simple input, thus saving time and effort for writers (Brown et al., 2020). In research writing, AI tools have the potential to improve accuracy with reduced errors (Khabib, 2022).

Conversely, AI writing tools have disadvantages. For example, they may not understand the context of a piece of writing and, therefore, suggest responses that are not helpful or even erroneous (Burkhard, 2022). They lack creativity (Bozkurt, 2023) because the content lacks a unique voice or perspective, and there are concerns about privacy (Tlili et al., 2023) since some tools collect user data to improve their algorithm.

Additionally, Owan et al. (2023) listed several challenges of using AI-powered tools in educational assessment. Some challenges are research concerns such as the lack of stakeholders' participation in developing AI tools, lack of transparency, bias of AI data, limited scope, ethics (e.g., issues on data privacy and ownership), inadequate training, integration with existing systems, cost, etc. Notably, AI-generated text is an existential concern challenging academia (Roe et al., 2023).

2.2 Enhancing Writing Skills in the Digital Age

The proliferation of online writing tools has made it easier for writers of all skill levels to access AI tools to improve writing (Gayed et al., 2022; Marzuki, 2023). From spell-checkers to grammar checkers, from writing prompts to plagiarism-checkers, there is a multitude of online tools that help writers improve work quality and accuracy. In this digital age, where the demand for quality writing increases, AI writing tools are invaluable resources for anyone looking to improve their writing skills. They are a promising tool that assist students in learning and developing writing skills and have the potential to enhance traditional training methods, which can contribute to more effective writing skill development when integrated thoughtfully into educational practices (Nazari et al., 2022). However, it is still important that writers develop their writing abilities without relying too much on these tools or that these tools be used responsibly by balancing online writing assistance tools with the traditional methods, in order for them to

maximize these resources to enhance writing ability and produce high-quality work.

Marzuki et al. (2023) reported the use of AI-powered writing assistant tools to improve students' writing quality and generate ideas and organize thoughts. It was discovered that AI writing tools used in English as foreign language instruction provide a comprehensive learning environment and improve students' overall academic performance. However, Burkhard (2022) found that students have varying perspectives toward AI-powered writing tools, as some use them uncritically, while others may not use writing tools at all, owing to skepticism.

AI tools' main function is to help individuals improve their writing ability. These tools have the potential to revolutionize the writing process for both professional and casual writers. As a result, these tools can lead to more polished, high quality writing. Hence, the use of these tools may have both positive and negative effects on writing ability.

While some studies have found benefits in terms of improved writing quality and increased independence, other studies suggest that these tools may not always lead to significant improvements and may contribute to plagiarism. Educators, therefore, need to carefully consider the role of AI tools in writing instruction and ensure that their use is balanced with other methods that promote the development of students' writing skills. AI writing tools are beneficial, but they are imperfect as they are still evolving, with their own set of benefits and challenges.

It is understood that AI writing tools are an excellent option for those wanting to save time or make work easier. Although AI is great in lessening workload (Huang et al., 2020), writers cannot depend on it entirely.

2.3 AI in Philippine Higher Education and its Impact

Rosales et al. (2020) explored technological adoption and its impact on higher educational institutions in the Philippines. Artificial intelligence is identified to have negative impacts but it can also help in producing employment through proper talent training. With this, people need to have a comprehensive and accurate understanding of the benefits of AI to avoid misconceptions about its disadvantages. Schools need to collaborate with the government to ensure that the graduates' skills are developed through the help of AI tools.

Concepcion et al. (2019) pointed out that artificial intelligence was seen as disruptive to industries; however, it is continually accelerating as it has been occupying many facets of society, such as education. In education, for example, AI may not replace non-digital jobs that perform heavy load or repetitive tasks but it helps a lot in ensuring that there would be no manpower shortage. The integration of AI tools in education can be helpful in integrating relevant technologies that can be useful for providing services.

Additionally, Wang et al. (2021) focused on teachers' intentions in integrating AI in their classrooms. By looking into the factors that affect these intentions, the researchers determined that teachers' self-efficacy positively influenced their perceived ease of usage and attitude towards AI and impacted perceived usefulness through perceived ease of usage. Also, it was found that enhancing teachers' self-efficacy could reduce their anxiety in employing AI tools in teaching. In using AI or identifying its purposefulness, it is important to identify the factors and decisions in using AI in education.

Melchor et al. (2023) reported initiatives, such as the National AI Roadmap and the National Centre for AI Research, demonstrating the Philippines' commitment to integrating AI to education. Similarly, universities are adopting smart campus concepts using digital technologies like AI and internet of things (IoT) to enhance operational efficiency and user experiences. The researchers concluded that integrating AI in education offers a potential opportunity to revolutionize the learning experience, especially for Generation Alpha students, despite the challenges related to social interaction, assurance, and data privacy. In education, the presence of AI is intense. It may affect students' critical thinking skills as some students may become dependent on writing their research projects. The presence of AI should bring space for researchers to provide innovative learning experiences.

ChatGPT's launch has sparked widespread concerns among members of the scientific community and involved discussion about the ethical use of artificial intelligence. The results generated by ChatGPT can be leveraged to improve efficiency and accuracy in the writing process but can also be used to plagiarize. This, undoubtedly, constitutes scientific misconduct. There are AI-countermeasures, such as AI-detector and watermarking, that have evolved to identify "AI plagiarism." Any use of AI tools to write should be declared and acknowledged, just as articles are referenced and cited (Koo, 2023).

Estrellado and Miranda (2023) argued on academic concerns and challenges of AI in education, starting points for data center hubs, possibilities for improved learning experiences, making decisions based on data, and anticipated opportunities. They believed that these are critical components in creating a successful and inclusive technology-integrated education system which will depend on a robust technological infrastructure, and adequate computing resources aligned with the policy frameworks, addressing data privacy concerns, digital equity, and faculty training.

3. Methodology

3.1 Research Design

The researchers used descriptive research and text mining techniques. The corpora were processed using the data analysis known as "text mining" to find patterns, trends, and relationships in the data (Manning et al., 2008). Text mining algorithms were used in analyzing a large corpus of written responses from the Google forms. The techniques used in this study were NLP, machine learning algorithms, and statistical analysis.

3.2 Study Respondents

The respondents were the faculty members from 11 public and private higher education institutions (HEIs) in the Philippines. Of these, three are located in Luzon, five in Visayas, and three in Mindanao. The number of faculty respondents from each participating HEI is shown in Table 1. The respondents were selected through convenience and purposive sampling by the research-collaborators of the participating institutions.

The criteria in selecting the faculty respondents of this research were that they were (a) engaged in research, (b) used or had been using writing assistance tools, and (c) intent to use writing assistance tools. Table 1 presents the research respondents from the 11 higher learning institutions.

Table 1: The research respondents from various higher learning institutions

Higher Education Institution	Number of Faculty Respondents	Percentage of Responses
Public HEI 1	23	7.03%
Public HEI 2	28	8.56%
Public HEI 3	34	10.40%
Public HEI 4	36	11.01%
Public HEI 5	15	4.59%
Public HEI 6	32	9.79%
Public HEI 7	96	29.36%
Public HEI 8	6	1.83%
Private HEI 1	13	3.98%
Private HEI 2	14	4.28%
Private HEI 3	30	9.17%
Total	**327**	**100%**

With regard to sex, 195 (59.63%) are female respondents, while 132 (40.37%) are male respondents. In terms of number of years engaged in research, 213 (65.14%) are less than five years, 74 (22.63%) are in between six and 10 years, and 40 (12.23%) are over 10 years. When asked about the use of writing assistance tools in research, 247 respondents (75.53%) have been using AI tools, while 80 (24.46%) have the intention to use the tools. The writing assistance tools that they have been using or have the intention to use are stated in Table 2. These tools are used in combination with other tools (e.g., ChatGPT & Quillbot).

Table 2: The various writing assistance tools used and intended to use by the faculty respondents

Research Writing Assistance Tool	Frequency	Percentage
Grammarly	277	84.71%
Quillbot	129	39.44%
ChatGPT	51	15.60%
Free Grammar Checker	72	22.02%
Ryter	3	0.92%
Jasper	5	1.53%
Copy Genius	6	1.83%
Jenie.AI	2	0.61%

3.3 Data Collection

The data were collected upon the approval to conduct the study. The Google forms contained four profile questions, which comprised of sex; number of years engaged in research; intention to use or had been using AI tools, and the tools that they had used or intended to use; and three open-ended questions about the usefulness of the AI tools, their positive and negative implications, and concerns in using these tools in research writing. A statement on data privacy was in the Google form. A total of 288 responses was retrieved from the Google form, and 39 hard copies were retrieved from the areas where internet connection was unstable. The hard copies of the responses were manually added to the retrieved data, then extracted in csv (comma-separated values) format.

3.4 Data Preprocessing, Cleaning, and Processing

The text mining methods used in this study were adapted from the studies of Bringula et al. (2022). Figure 1 shows the preprocessing steps performed on the responses to have them ready for NLP. Basic text cleaning involved removing special characters and numbers that did not add value to the analysis and lowercasing the responses. Unigram tokenization was used to divide the sentences into individual words. Stopwords removal eliminated the common and/or unnecessary words, such as articles. Part-of-speech (POS) tagging involved finding and labelling text as nouns, adjectives, verbs, etc., as they are essential parts of thought. Lemmatization returns the base or dictionary form of each word.

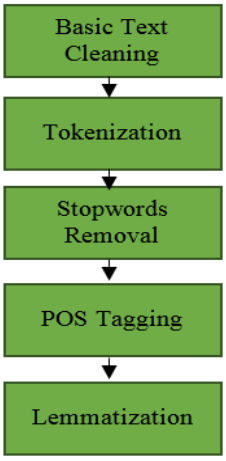

Figure 1: NLP preprocessing steps

3.3 Data Analysis

K-means clustering is a machine learning algorithm used to group data points into clusters so that data points within the same cluster are more similar to each other. K-means clustering and sentiment analysis were used to analyze the text corpus. For the helpfulness and concerns in using writing assistance tools in research, the elbow method of k-means clustering was used. The faculty respondents' responses on positive and negative implications of writing assistance tools were determined using sentiment analysis adopted from the studies of Cahapin et al. (2022) and Santiago et al. (2022). They performed sentiment analysis to obtain the

polarity (positive and negative), based on the perception of students towards the implementation of limited in-person learning and students' experiences of online learning, anchored on a lexicon-based approached. The R software version 4.3.0 was used for k-means clustering and sentiment analyses. The sample data before and after preprocessing are depicted in Figures 2 and 3.

	text
1	This could minimize the time spent in conceptualizing ideas.
2	Generally, I use Grammarly for proofreading grammar lapse...
3	For correcting grammar and spellings
4	these can make the entire writing process easier by doing th...
5	More ease of checking and rechecking
6	None
7	Generally acceptable
8	Make writing correct and easy
9	make your work easy, especially the grammar
10	Based on my views and readings, i think these writing assist...
11	It makes your work more scholarly and professional.
12	quick backgrounder on the topic, ensure acceptable gramm...
13	Help me to write better without grammatical errors. Also giv...
14	It can transform my manuscript from grammar errors
15	Easily

Figure 2: Sample data before preprocessing

preprocessed_docs	list [328]	List of length 328
[[1]]	character [1]	' minimize time spent conceptualizing ideas '
[[2]]	character [1]	'generally use grammarly proofreading grammar lapses might missed work use quill ...
[[3]]	character [1]	' correcting grammar spellings'
[[4]]	character [1]	' can make entire writing process easier grunt work writing leaves us focus subs ...
[[5]]	character [1]	' ease checking rechecking'
[[6]]	character [1]	'none'
[[7]]	character [1]	'generally acceptable'
[[8]]	character [1]	'make writing correct easy '
[[9]]	character [1]	'make work easy especially grammar'
[[10]]	character [1]	'based views readings think writing assistance tools provide ease transforming t ...
[[11]]	character [1]	' makes work scholarly professional'
[[12]]	character [1]	'quick backgrounder topic ensure acceptable grammar support paraphrasing '
[[13]]	character [1]	'help write better without grammatical errors also gives good suggestions'
[[14]]	character [1]	' can transform manuscript grammar errors'
[[15]]	character [1]	'easily'

Figure 3: The final corpus after data cleaning and processing

4. Results and Discussion

4.1 Helpfulness of writing assistance tools in research

Table 3 presents the 10 most frequently used words in the corpora and shows the insights on the perceptions and experiences of individuals using writing assistance tools. Tools for editing and writing have the potential to be very beneficial during the research process. Researchers typically need assistance with a variety of tasks, including grammar, idea generation, research organization, writing skill development, and in increasing the effectiveness of the entire research process. Writing support tools may considerably improve the research process and help produce high-caliber academic work by attending to these demands.

Table 3: Ten most frequently used words in the corpus

Rank	Word	Frequency	Sample Sentence
1	Help	104	"Writing assistance tools can help you by automating tasks such as proofreading or formatting."
2	Work	104	"Using these kinds of tools will get my work done faster and make me convince that my work was good enough."
3	Grammar	87	"It transforms my research into a different level in terms of vocabularies and grammar it helps me to construct sentences easily."
4	Make	74	"These tools makes my work more accurate and done more efficiently."
5	Research	59	"It has the potential to transform research writing endeavors by improving the general structure of a research paper - its coherence, clarity and readability."
6	Correct	56	"These tools help to correct my works and somehow, they also made my works accurate."
7	Write	54	"Help me to write better without grammatical errors."
8	Tool	51	"I think these writing assistance tools provide ease in transforming or transcribing research articles into a publishable article."
9	Easier	38	"It makes my work easier as I don't have to manually check the grammar in my writing."
10	Improve	32	"The tools provide options and suggestions to improve the clarity of my writing."

The dataset was clustered using k=2. Figure 4 shows the result of k-means clustering. The cluster plot for k-means applied on the dataset is shown in Figure 4. The findings of the elbow technique show that the variation explained by the clusters did not significantly improve after k=2. This suggests that the data points were best categorized into two distinct clusters, revealing a clear difference in viewpoints regarding the usefulness of writing aid tools in research. The elbow method-informed choice of k=2 allowed the researchers to evaluate the data simply and derive practical lessons that could help educational institutions that wish to improve their research procedures.

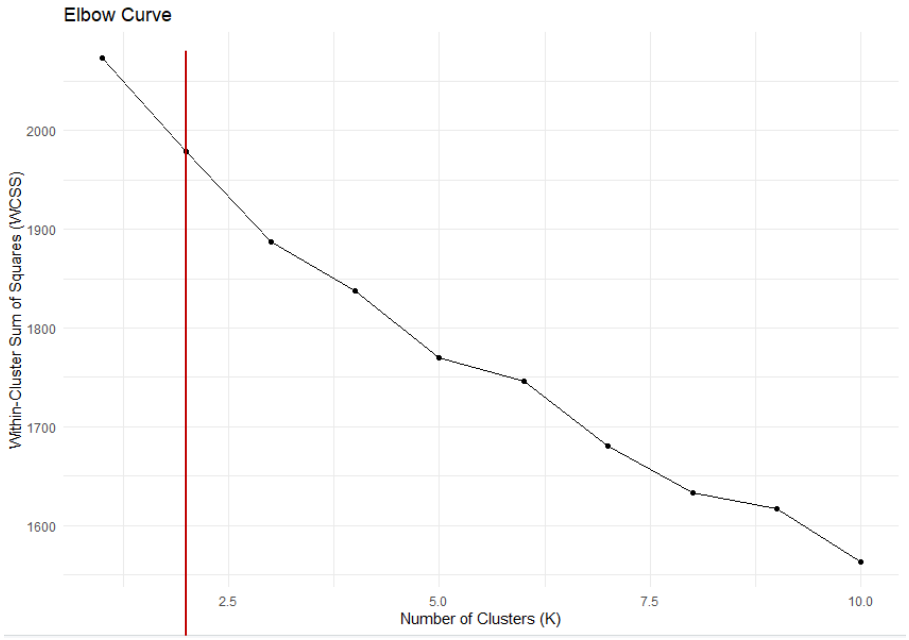

Figure 4: Elbow method showing the optimal number of clusters

Cluster 1 represents a group of words that are closely associated with the research and writing process, including the tools and assistance used to improve quality and effectiveness. It suggests a theme of seeking help and support in research and writing endeavors, with the goal of enhancing the final written products, such as papers and articles.

Meanwhile, Cluster 2 represents a group of words closely associated with the practical aspects of using writing assistance tools. It focuses on how these tools help users with grammar and correctness, making the writing process easier, and enabling more efficient checking and correction of written content. The cluster suggests that these discussions might be relevant in both research and general writing contexts.

Table 4: Labels of k-means clusters

Cluster 1	Cluster 2
research	help
write	work
tool	grammar
help	make
work	correct
can	write
provide	tool
improve	research
paper	easier
article	check

The result on the helpfulness of writing assistance tools in research implies that the faculty respondents generally regarded writing assistance tools as highly useful. The respondents utilize a variety of tools for multiple purposes, including proofreading, paraphrasing, language translation, formatting, punctuation and

spelling checks, refining grammatical structures, and detecting plagiarism. Overall, these tools significantly contribute to enhancing the quality and integrity of research work. For example, ChatGPT, as one generative tool for research writing mentioned in this paper, can generate coherent and grammatically correct text (Annals of Family Medicine, 2023).

Writing tools have been proven invaluable to faculty researchers, offering numerous benefits such as enhancing the clarity and appeal of their research papers, expediting the writing process, ensuring freedom from grammatical errors and plagiarism, simplifying complex ideas while maintaining comprehensiveness, and facilitating reader understanding. These assistive writing tools save time and effort since they are simple and efficient (Chang et al., 2021; Gayed et al., 2022; Jeanjaroonsri, 2023; Zhao, 2022). Yang et al. (2022) discovered that users of AI found inspiration in unexpected text produced; that users anticipated reduced fluency and coherence when given the opportunity to edit the output; and that users had a mental model of the AI as an active writer in the collaborative process.

The use of these tools within academic research has elevated the quality of the faculty members' outputs across various levels. Tools like Grammarly can aid students and teachers in improving writing quality (Karyuatry et al., 2018). According to Huang et al. (2020), using Grammarly can help students improve their writing skills and help teachers reduce their workload. Likewise, Jarrah et al. (2023) found that ChatGPT is a valuable writing tool. It is evident that writing assistance tools can transform written works into more coherent and professional pieces. Notably, these tools also improve users' writing skills by providing accurate and clear sentence structures. While the output may emulate a human-like pattern, it enhances efficiency and reduces human errors in grammar and spelling. Consequently, faculty researchers gain additional time to focus on writing important aspects of their research, potentially resulting in publishable research outputs. Khabib (2020) asserted that for educators who want to write scientific publications, AI-based digital writing aids may be able to offer an alternative approach. This is done by an automated, repetitive, and less time-consuming task (Kooli, 2023).

The utilization of writing assistance tools can greatly enhance research work by making sentences more active and facilitating the effective communication of ideas. Many faculty respondents have found these tools to be invaluable assets in their job performance, enabling them to easily express their thoughts. Therefore, incorporating such tools proves highly effective in various aspects of writing. The result of this study further suggests significant opportunities for improvement. First, a more creative mindset can be nurtured, enabling the generation of innovative and unique work. Second, the ability to identify errors swiftly and rectify them can be improved, leading to increased precision. Third, the faculty members could feel at ease expressing their own perspectives and thoughts, resulting in more distinct and personalized contributions to their respective fields. With these, they may have embraced the opportunity to advance their theories, taking ownership of their work and advancing their studies further.

4.2 Positive and negative implications of writing assistance tools

Table 5 shows the 10 most frequent words in the corpora and the sample sentences that illustrate both the positive and negative implications of using writing assistance tools in research. These tools are seen as useful aids in improving writing and research skills. The faculty researchers reported that the grammatical errors can be quickly identified and that AI tools provide complex ideas that fit into their writing.

There are concerns that overreliance on these tools may reduce their critical thinking and produce original ideas. Some faculty respondents were concerned that students may rely too much on these tools for their academic work, which will disrupt the overall development of their writing skills and may not always result in demonstrating their excellence in communication. The use of these technologies can cause difficulties with academic integrity, such as plagiarism or infringement of intellectual property. Even though they give users the opportunity to improve their linguistic skills, there are also warnings about potential pitfalls, such as neglecting the importance of professional language editors and not critically evaluating the information proposed by the tools.

Table 5: Ten most frequently used words in the corpus

Rank	Word	Frequency	Sample Sentence
1	Research	158	"Positively, the tools help students avoid grammatical errors and provide complex ideas for enhancing their research. But in a negative way, researchers start to depend excessively on AIs."
2	Tool	144	"In a positive view, these tools will help students finish their work quickly. In a negative view, students will probably rely more in using these tools when doing school works which doesn't work well sometimes."
3	Position	119	"There is no negative implications in using this tools; it's position implication is it'll help students gather more information"
4	Help	99	"The positive implication of these tool is to improve my knowledge the English language by showing my mistake and errors and the negative implication is it is only check sentence structure it will not help you produce better ideas and not group your ideas in to a logical sentence for better outcomes."
5	Implication	93	"The positive implication would be finding the right words to use and to create formal type of discussion; the negative implication, however, is it will lead the person not to critically assess the information by the self and rely only to what is being suggested."
6	Negative	74	"It is efficient to use and it aid us in doing some heavy tasks. Although negative implications might perceived in using those tools like is the dependency of an individual in using it."
7	Will	71	"It will increase productivity and efficiency of the researcher but will develop cheating and would lead to violation of intellectual property rights of others."
8	Use	70	"It is a great help. Users may end up dependent on these tools."
9	Write	66	"I think the tool that I am using does have a positive effect because you able to learn how to write much better."

10	Grammar	64	"It will positively assist the researchers in the HEIs in terms of language editing. While, it will also pose a negative implication by way of disregarding the professional language or grammar editors."

The overall polarity of sentiment scores of positive and negative implications of using writing assistance tools in research is shown as positive and negative. As a result of the analysis, Figure 5 shows that using writing assistance tools in research is dominated by positive implications (77) compared to negative implications (61).

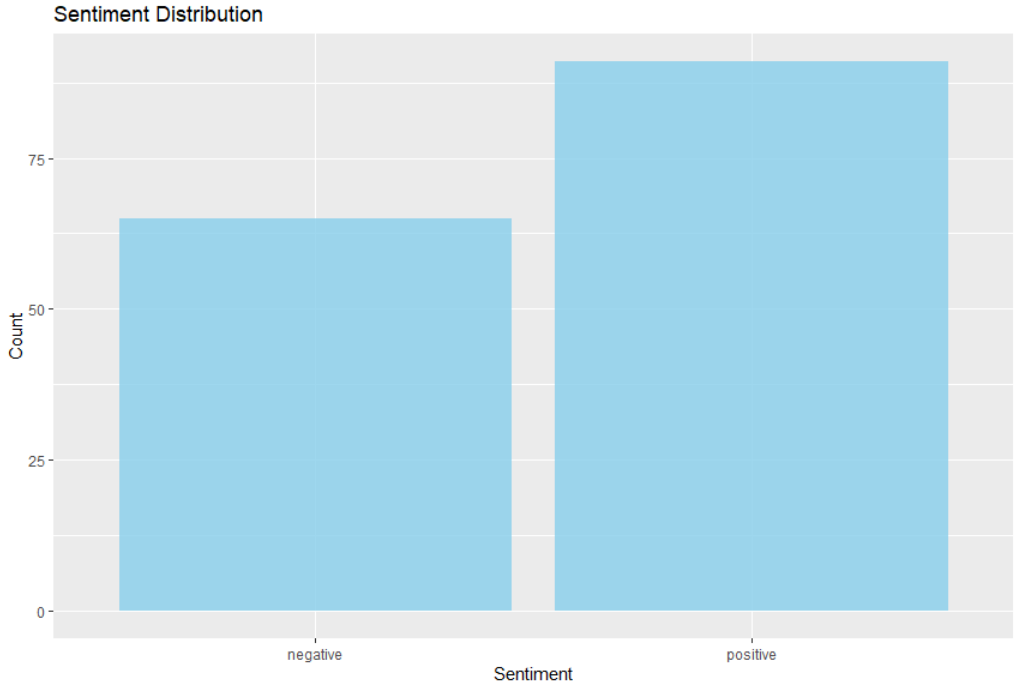

Figure 5: Overall sentiment analysis of positive and negative implications of using writing assistance tools in research

The faculty researchers' opinions and an analysis of the implications of generative writing assistance tools in research agreed that there are positive and negative aspects. Considering the positive sentiments, these tools serve as important aids for non-native English speakers in improving and refining their writing skills, which are critical to producing relevant and polished research. They found these tools empowering, particularly in the context of technical writing, with a little intervention of using other traditional tools. Kooli (2023) asserted that these tools can efficiently collect and process data, and their constant availability enables all-the-time data access. Also, personalized services enhance research objectivity, efficiency, and individualization. When several writing aspects are streamlined, faculty researchers can save invaluable time and effort, which leads to increased self-efficacy and less efforts for higher writing outcomes. Alharbi (2023) asserted that similar to any technological advancement, AI-driven writing aids can significantly contribute to the transformation and improvement of individuals' writing abilities and research productivity. These tools should be viewed as a means to enhance and elevate writing (Carvalho et al., 2022).

The ability to aid users in understanding complex ideas is one of the significant benefits of AI tools that simplify and tailor information according to the researchers' needs. They also agreed that these tools facilitate comprehension and enhance the clarity of written work.

Those who have experienced these tools may have developed critical thinking abilities and will get more from interactions since they can engage with the content critically (Stojanov, 2023). Furthermore, the faculty researchers emphasized the importance of these tools in their current roles and highlighted that using such tools not only boosts their confidence in writing but also fosters creativity and encourages continuous learning. Significantly, it instills confidence as it reinforces writing autonomy, experiences, and engagement (Dwevide et al., 2023), especially when the tools allow them to scrutinize their errors and identify incorrect writing patterns, even in the absence of human support (Nazari et al., 202). Hence, by effectively leveraging these tools, researchers develop their writing skills and become more adept at articulating their ideas. These tools empower users to become content creators, capable of generating well-structured and coherent writing.

In the educational context, these tools can be utilized as models to teach learners responsible and effective writing practices. Faculty members can demonstrate how to use the tools responsibly, ensuring that students grasp their full potential while understanding their limitations.

The role of teachers in modeling effective technology integration is crucial in preparing modern classrooms. The best practices, strategies for overcoming challenges, and a willingness to adapt should be demonstrated to confidently and purposefully integrate technology to enhance student learning outcomes — be it in subject requirements or research output. The use of generative writing assistance tools can play a crucial role in validating the authenticity of research work. Helping writers produce grammatically correct and coherent texts, these tools contribute to the overall credibility and professionalism of the research output.

Studies on improving writing skills through generative writing assistance tools support these thoughts. The use of tools enhances the creation of knowledge and the development of new competencies (Scardamalia & Bereiter, 2015). ChatGPT, for instance, being used by faculty respondents of this paper, was revealed by Tlili et al. (2023) as favorable for the public when used in educational settings. It resonates deeply within the realms of education, cognitive development, and innovative thinking; magnifies the transformative potential of tools as enablers of intellectual evolution; and illuminates how people's interaction with tools not only amplifies cognitive capacities but also propels into the forefront of knowledge innovation.

Alternatively, the faculty respondents highlighted several negative aspects of using generative writing assistance tools in research, primarily focusing on the risks of overreliance. They expressed concern that excessive dependence on these

tools may lead to a decline in critical thinking and creativity among users. These concerns were also expressed by Bozkurt (2023). While generative writing assistance tools offer speed and convenience, some lack contextual understanding (Yang et al., 2022), resulting in incorrect suggestions that may alter the intended meanings of the text.

In contrast, there has been an increasing agreement that the use of writing assistance tools can lead to a significant improvement in writing quality and productivity (Kooli, 2023). However, it is noteworthy that their implementation takes place in a way that is appropriate to the context of what the writer wants to write (Nunes et al., 2022) because it is a machine and does not have a human level of comprehension or context awareness (Huang & Wilson, 2021; Bozkurt, 2023). According to Marzuki et al. (2023), the foundation of writing is its content. The content conveys the messages, ideas, and thoughts that the author wishes to communicate. It is a reminder of the pivotal role that meaningful and well-crafted content plays in effective communication. It is the foundation upon which the entire writing experience rests, shaping the reader's understanding, engagement, and connection with the author's ideas and messages. To achieve the best results and not change the context with these tools, factors such as the type of writing task, the user's skill level, and the overall writing goals need to be considered. Also, these tools might not always detect or correct improper grammar usage accurately, posing a risk to the credibility of the writer's work. The tools' outputs are susceptible to errors in content due to data inaccuracies, potentially compromising research quality.

Using such tools may inhibit writers' thought process and diminish the originality of their work. This discourages researchers from learning, developing, and constructing their own unique ideas, potentially stifling academic growth. These apprehensions are valid, as these advanced tools offer writers translations and rephrased sentences and produce texts that are nearly on the same level as human capability (Bozkurt, 2023; Floridi, 2023; Lim et al., 2023) and quality. Furthermore, these tools provide substantial portions of text instantly with just a simple click, enabling learners to easily insert the intelligently generated suggestions into their written work, often without engaging in much, if any, actual learning (Alharbi, 2023).

The faculty respondents pointed out the potential for academic integrity and plagiarism issues that could affect not only themselves but also their students. Hence, before rushing to implement AI-generative tools, it could be worthwhile to first assess how students and educators see and understand them (Stojanov, 2023). Relying too heavily on these tools might lead to a loss of discipline in writing, hinder creativity, and impede personal development. Another concerning aspect is the dependency on these tools, which could weaken researchers' capabilities, resulting in a shallow comprehension of the subject matter and impede the growth of the abilities (Kooli, 2023) to write and conduct research independently. Ethical concerns arise, including the possibility of misinformation, biased data, and potential replacement of human efforts with automation, raising issues related to intellectual property and plagiarism.

4.3 Concerns in Using Writing Assistance Tools in Research

Table 6 presents the 10 most frequently used words in the corpus, along with sample sentences reflecting the concerns of faculty respondents in using generative writing assistance tools in research. The users expressed concerns about potential overreliance on these tools, which may lead to a decreased effort in constructing well-organized sentences and using correct grammar and spelling. Some of the faculty respondents worried that researchers might excessively depend on AI, hindering the development of essential research and writing skills. However, others viewed these tools positively, appreciating their relevance and assistance in improving writing capabilities.

It is emphasized that these tools should only serve as support, not replace the core of research work. While they can enhance accuracy, users remain cautious of errors introduced by the software. Users should also be mindful of the subscription fees and the need to understand the logic behind the tool's suggestions to ensure the quality of their articles. The use of generative writing assistance tools offers both benefits and challenges, and striking the right balance between reliance and personal effort is crucial for effective research and writing outcomes.

Table 6: Ten most frequently used words in the corpus

Rank	Word	Frequency	Sample Sentence
1	Tool	158	"The only concern when using these tools is that the researcher may feel at ease and will not focus on the construction of their sentences including grammar and spelling."
2	Research	144	"The main concern is that researchers may overused the AI tools and stick to it all the time and allow AI to do all the job in making research."
3	Use	119	"…as long as the researcher will use it positively, than reliant on the AI to do the job for them."
4	None	99	"None personally. I truly appreciate the relevance of these tools. Maybe we should be reminded that these tools that are supported by AI is for support only and not the core of research tools."
5	Concern	93	"My only concern is the ability of improving one's capability in writing a research or study."
6	Write	74	"…many student depends on this tools and didn't make any effort to write their research papers."
7	May	71	"Too much dependence on these tools may hinder users from developing research skills and writing skills."
8	Help	70	"While writing assistance tools can help improve accuracy, there is always the risk of errors or inaccuracies being introduced by the software itself…"

9	Will	66	"…the subscription fee and its coherence to understand the logic of the statements that will eventually pose different thought in transforming the articles."
10	Depend	64	"…people might depend on these tools too much that they (the tools) can be used more than they should be in the context of research…."

The dataset was clustered using k=2. Figure 6 shows the result of k-means clustering. The cluster plot for k-means applied on the dataset shown implies that the underlying structure of the data can be meaningfully and significantly represented by grouping the concerns of the faculty respondents into two different groups. The concerns about using writing aid tools for research are grouped into these two clusters because they are the most prevalent and most identifiable. By choosing a two-cluster strategy, the researchers hope to properly summarize the range of opinions indicated by the respondents while also capturing the primary dichotomy or polarization of issues.

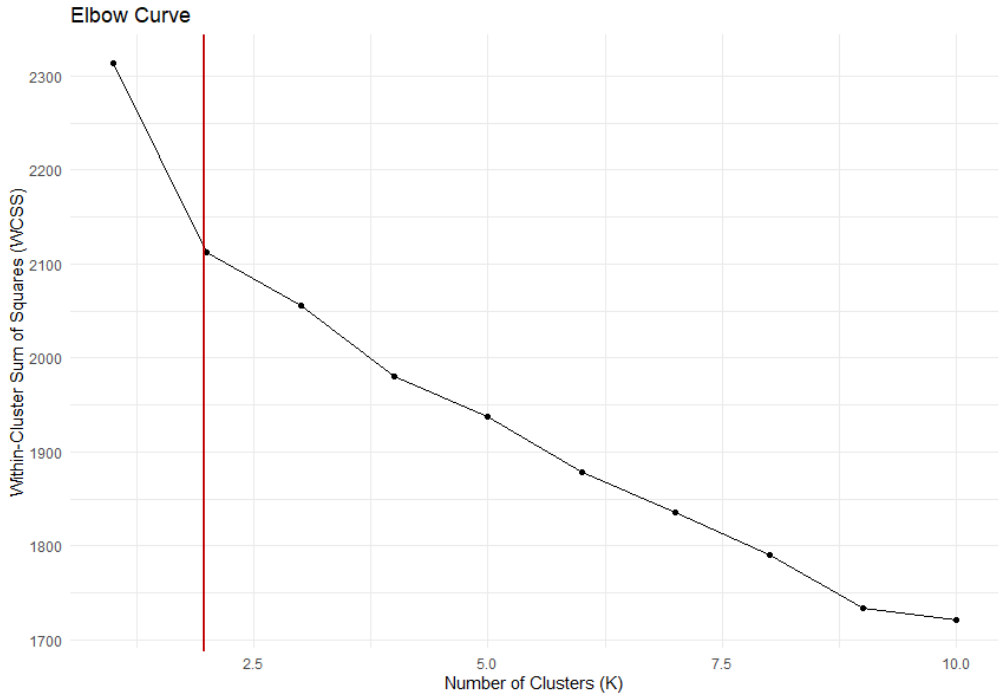

Figure 6: Elbow method showing the optimal number of clusters

Cluster 1 represents a group of words that are closely related to the usage and concerns associated with writing assistance tools. Researchers in this context are concerned how these tools can be helpful or worrisome; how they are used in the research process; and the extent to which they are relied upon. The cluster indicates considerations about the role and impact of these tools in research activities.

Cluster 2 represents a group of words closely associated with concerns, uncertainties, and potential issues related to the use of writing assistance tools.

Researchers are concerned about the efficacy, reliability, or limitations of such tools, as well as the uncertainty surrounding their use. The cluster indicates the considerations about the potential disadvantages and uncertainties associated with reliance on these tools in research activities.

Table 7: Labels of k-means clusters

Cluster 1	Cluster 2
tool	none
research	tool
use	research
concern	use
write	may
depend	help
will	something
can	free
help	grammar
make	concern

The utilization of writing assistance tools in HE research is an increasing concern among researchers. While these tools offer promising features and can be beneficial, their drawbacks have raised concerns about their impact on critical thinking, academic integrity, and research quality. In this case, it is crucial to be aware of the risks involved and to take action to reduce them (Akgun & Greenhow; 2021, Liu et al., 2022; Lund & Wang, 2023; Qadir, 2022).
Writing assistance tools undoubtedly serve as important aids, particularly for those learning to write. The tools ability to provide support and guidance can empower novice researchers to improve their writing skills. However, carelessness in their use can lead to errors, inaccuracies, and a lack of contextual information. As mentioned by Yang et al. (2022, p. 2), "Machines cannot fully understand the intentions of human writing." Thus, while beneficial, these tools cannot replace human intellect and expertise in crafting high-quality research papers. Kooli (2023, p. 10) stated that generated research results "require human interpretation and evaluation to be meaningful and actionable." The Annals of Family Medicine (2023) asserted that generative technologies, like ChatGPT, cannot produce the kind of complex analysis needed for scientific research that is publishable.

A significant concern raised by faculty respondents is how these tools can impact researchers' critical and analytical thinking. While these tools offer efficiency in data collection, availability, and personalized services, there is apprehension about the unintended consequence of reduced reliance on human cognitive abilities. The convenience of readily available information and tailored responses might inadvertently discourage researchers from engaging in in-depth analysis and critical evaluation. Overreliance on these tools could diminish the habit of scrutinizing information sources, cross-referencing data, and developing a nuanced understanding of research subjects. Additionally, it may result in a diminished capacity for independent analysis and interpretation, hindering the development of researchers' full potential in various aspects of research writing. Relying on any generative writing assistance tool goes against the fundamental

aims and principles of education (Kooli, 2023). Therefore, it is essential for educators to encourage students and researchers to strike a balance between using writing assistance tools as aids and developing their analytical skills without tools.

Writing aids' generative techniques produce data that need thorough evaluation and critical thought. The materials generated by these tools are frequently superficial and require scholars to go into various sources to check the content's correctness and dependability. Failure to do so jeopardizes the author's academic credibility and puts the research reputation into question. Hence, it is crucial to instill a sense of responsibility, accountability, and academic integrity for checking and using data generated through these technologies. Their impact on research from an ethical perspective is important to ensure the reliability, validity and purposiveness of the results obtained for decision-making. In this case, Thurzo et al. (2023) advocated upholding rational decision-making of what is morally and legally appropriate.

The faculty respondents also expressed apprehensions about the potential misuse of writing assistance tools for cheating and plagiarism. Many cautioned against utilizing writing assistance tools in educational contexts. This may be because of the implementation of AI technologies in education, which has caused several challenges, with ethical considerations standing prominently (Melchor et al., 2023; Jarrah et al., 2023; Bozdag, 2023).

Tlili et al. (2023) warned about cheating, honesty and truthfulness, and even privacy, misleading information, and manipulation. These academic misconducts pose serious concerns in academic writing (Kooli, 2023; Tlili et al., 2023) and learning authenticity (García-Peñalvo, 2023). Qadir (2022) raised ethical concerns about the potential for unethical or dishonest use, while Thurzo et al. (2022) mentioned a growing concern about its ethical and legal implications. Technologies have limits of which researchers must be aware. The easy accessibility of many free tools, as well as the limited scope of premium services, make them appealing avenues for unscrupulous practices.

Kim and Kim (2020) discussed the potential writing problems that may be caused by these tools, including the alteration of the role that instructors perform in the classroom and the transparency of the judgments made by these tools. A multifaceted strategy combining cooperation among educators, technologists, legislators, and society at large is needed to address these issues. While prudence and cautious use is preferable (Tlili et al., 2023), decision-making by researchers should be open, responsible, and consistent with ethical principles.

Seo et al. (2023) stated that students and instructors were concerned about the loss of privacy because of AI's excessive data collection, and they felt that AI would impede their ability to learn freely. Hence, as educational institutions increasingly embrace AI-driven tools to enhance teaching and learning experiences, concerns regarding data privacy, algorithmic bias, and the potential for replacing human educators must be open to dialogue between the researchers from the academe

and the AI industry. To fully realize the benefits of AI in research writing, it is crucial to address the challenges and ethical considerations that arise and ensure that AI-powered research and education remain accessible and equitable for all.

5. Conclusion

The findings of this study unpacked that the faculty respondents highly value writing assistance tools by using them for proofreading, paraphrasing, and many more. The tools significantly contribute to improving the quality, efficiency, and clarity of research work, thereby elevating the standards of academic output. Faculty members gain inspiration from AI-generated texts, reducing errors, saving time, enhancing their research, and fostering creativity. AI-generated texts also serve as models for teaching responsible writing practices and validating research authenticity. This positive impact is seen as beneficial not only for individual researchers but also for academes seeking to enhance their research experience.

However, overreliance on AI tools can hinder critical thinking and creativity, and pose risks of incorrect suggestions and plagiarism. Implementing these tools must consider context and user skills. Despite concerns, these tools have transformative potential but require responsible use to avoid diminishing writers' originality and academic growth. The utilization of writing assistance tools in HE research has caused increasing concerns. AI tools aid novice writers but must be used cautiously due to limitations as they can diminish critical thinking and encourage overreliance. There are concerns about academic integrity, plagiarism, and ethical issues.

To ensure the responsible use of AI-driven tools in research and education, institutions must establish clear guidelines on the ethical use of writing assistance tools and enforce strict policies regarding plagiarism and academic dishonesty. Higher learning institutions may adopt these tools, but they need to ensure ethical and responsible use, including the consideration of a multi-pronged approach that includes advanced detection tools, proactive prevention measures, educational campaigns, and ethical considerations. Moreover, the tools themselves should incorporate measures to discourage misuse and protect intellectual property rights.

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