



Grammarly Software-Based Editorial Intervention to Enhance Scholarly Writing Performance in Mathematics and Science Education

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Abstract

Grammarly is useful in the detection and correction of typographical and grammatical errors in written texts instantaneously. It makes suggestions to improve grammar, clarity, spelling, fluency, tone, and style in written documents. This study aimed to investigate the effect of Grammarly software on the writing quality of researchers in mathematics and science education in terms of performance, readability, and vocabulary. The study adopted a pretest-posttest design, to compare the research writing scores before and after the application of Grammarly for corrections. A total of 34 researchers who contributed 20 chapters to a book on Mathematics and Science Education formed the sample size of the study. Fourteen chapters had a pair of contributors each whereas six chapters had lone authors. Participation in the book writing project is the sole criterion for inclusion in the study. The descriptive (mean, and standard deviation) and inferential statistics (paired-sample t-test) were used for data analyses. The statistics showed that Grammarly significantly improved the researchers' overall writing abilities. However, there were no significant improvements in vocabulary or reading. We conclude that Grammarly helps improve the overall writing quality of authors and researchers in the field of academic publication. It was recommended among others that Grammarly developers should include more targeted feedback and suggestions on readability and vocabulary to help users improve their writing skills even further.

Keywords: Grammarly, Quality, Writing performance, Artificial intelligence, Readability, Vocabulary

Introduction

English has emerged as the global language for scientific communication and correspondence in our modern day. Scientific writing serves as a means for researchers to convey their discoveries to the scientific community. Scientific writing is essential for researchers to advance in their careers and establish their reputations. In today's highly competitive world, a researcher's success is measured based on their publications and the influence they have on the scientific community. Ultimately, the publication yields benefits in terms of employment opportunities, cooperation, and improved financial support. Proficient utilization of grammar and writing in English is a crucial component of academic writing. Scientific writing typically recommends that a draft be reviewed by a native English speaker to ensure grammatical quality and editing (Rao et al., 2019). In light of contemporary technical progress, a multitude of online tools for grammar and spelling checking have emerged, aimed at enhancing the quality of writing. Researchers and academicians are increasingly using these platforms, as some journals now suggest utilizing Grammarly and other similar applications. In scholarly writing, such as research reports, theses, and essays, it is crucial to generate coherent ideas with meticulously arranged, substantiated arguments and to approach diverse perspectives more impartially. Consequently, academic writing needs to be characterized by its clarity, directness, and unambiguity.

Grammarly, an integrated artificial intelligence application, offers writing assistance to researchers and academics by generating comprehensive reports on grammatical and other writing-related problems (Grammarly, 2023a). Grammarly thoroughly examines the author's writing to minimize errors in word usage, grammar, and mechanics (Benalileche & Kaouache, 2021; Ghufuron & Rosyida, 2018). This software offers automated feedback to authors, providing recommendations, corrections, and explanations to help them readily discover and comprehend problems

11 | Cite this article as:

Wonu, N., Kyeremeh, P., & Yarkwah, C. (2024). Grammarly software-based editorial intervention to enhance scholarly writing performance in mathematics and science education. *FNAS Journal of Mathematical and Statistical Computing*, 1(2), 11-19.

in their writing. Some studies demonstrate the efficacy of Grammarly as an automated writing evaluation tool in enhancing the quality of academic writing for authors and academics. This study aimed to investigate the impact of Grammarly in enhancing the quality of academic writing in the field of Mathematics and Science Education among authors. In this direction, we sought to test the following null hypotheses: Hypothesis 1: There is no significant difference in the writing performance scores of the researchers before and after text corrections with Grammarly application software; Hypothesis 2: There is no significant difference in the readability scores of the researchers before and after text corrections with Grammarly application software; and Hypothesis 3: There is no significant difference in the vocabulary scores of the researchers before and after text corrections with Grammarly application software. We commence by examining scholarly literature on Grammarly as an AI-powered software designed to assess English writing proficiency among researchers, scholars, and writers, and its efficacy in enhancing the quality of academic writing in the fields of Mathematics and Science Education. Subsequently, we outline our research approach, followed by the presentation of the study's findings and subsequent discussion. We present a comprehensive analysis of the findings and ultimately conclude.

Grammarly is an AI-powered software that assesses English writing and provides comprehensive comments on grammar and other writing concerns to researchers, scholars, and authors (Nova & Lukmana, 2018; Yousofi, 2022). Grammarly was established in 2009 by Maz Lytvyn, Alex Shevchenko, and Dmytro Lider, with the primary objective of facilitating proficient English writing and promoting successful communication. Grammarly is widely recognized as the most accurate and extensively utilized English grammar checker globally (Cavaleri & Dianati, 2016; O'Neill & Russell, 2019). Grammarly provides coaching services to more than 30 million individuals and 50,000 teams daily, intending to improve the precision, coherence, involvement, and presentation of their written work (Grammarly, 2023b). This is one of the reasons why Grammarly was named number 55 in Deloitte's list of fastest-growing companies (Cavaleri & Dianati, 2016). For writing a research paper, 88.6% of respondents said they use Grammarly, 53% used it for writing reports, and 45.5% for mailing purposes (Rao et al., 2019). It was also noted that Grammarly's registered users also use the program to write books, theses, and dissertations as well as to prepare presentations and maintain blogs.

The Grammarly software assesses grammatical errors, writing styles, and duplicate content, while also providing suggestions for synonyms to enhance compositions, among various other functionalities (Grammarly, 2023a; Perdana et al., 2021). The word processor provides a comprehensive range of more than 250 grammatical and contextual spell checks, enabling it to rectify errors with a frequency that is up to 10 times higher compared to alternative word processors (Grammarly, 2023a; Rao et al., 2019). In the Grammarly application, Calma et al. (2022) identified twelve kinds of writing difficulties that are noticed by the software, including clarity, readability, formality, diversity in language, concision, conventions, grammar, sensitivity, fluency, punctuation, and spelling. Perdana et al. (2021) assert that Grammarly is capable of identifying instances of plagiarism in written reports by a comparative analysis of the report's content with existing online written materials. The primary components of Grammarly consist of scoring and feedback algorithms. According to Bai and Hu (2017), the scoring and feedback engine offers automated scoring and written feedback, respectively. The classification of written corrective feedback in Grammarly, as proposed by Barrot (2021), encompasses three types: direct corrective feedback, which offers writers the correct forms of errors; indirect corrective feedback, which highlights writers' errors without providing explicit corrections; and metalinguistic corrective feedback, which either labels or acknowledges the mistake. Nova (2018) states that Grammarly offers two versions: a free edition and a premium version. The free edition of the software includes several features such as grammar, spelling, and punctuation checks. Additionally, it is capable of doing 150 different types of error checks. Furthermore, the premium edition of the software offers further features such as duplicate content detection and word recommendation, as well as the ability to assess over 400 distinct fault categories (Nova, 2018).

The utilization of Grammarly as a tool for supporting English writing has experienced a significant surge in popularity owing to its efficacy in enhancing the calibre of scholarly writing. Grammarly has garnered acclaim from scholars, authors, educators, and learners due to its ability to offer automated corrected input, hence enhancing writing proficiency and facilitating successful communication. The study conducted by Dewi (2022) aimed to investigate the attitudes of students regarding the efficacy of Grammarly as an automated tool for evaluating written drafts. This was achieved by the administration of questionnaires and conducting interviews. The results indicated that the utilization of the Grammarly application had a beneficial effect on the academic writing of students, serving as an automated tool for evaluating their writing skills. The advantages of utilizing Grammarly were enumerated, encompassing its aid in

detecting grammatical, punctuation, spelling, and lexical errors in written work, reducing errors in written output, enhancing paraphrasing skills, rectifying writing errors at any given moment or location, augmenting students' lexicon, and facilitating the identification of writing errors.

In their study, O'Neill and Russell (2019) employed a sequential explanatory design to examine the differences in student responses between the two groups. One group received feedback from Grammarly, while the other group received traditional non-automated grammar feedback from the Academic Learning Centre at CQUniversity in Australia. The findings indicate that students who received feedback from Grammarly perceived it as more beneficial compared to conventional non-automated grammatical comments. There was a positive correlation seen between the utilization of Grammarly by students and the guidance provided by an academic learning advisor. In their study, Jayavalan and Razali (2018) examined the potential positive impact of Grammarly on the narrative writing skills of secondary school students in Malaysia. The study utilized a quasi-experimental approach with non-equivalent control. The results indicated that Grammarly enhances the ability of students in the experimental group to write narrative essays by promoting the use of accurate grammar functions, particularly in sentence building. A mixed-method approach was utilized by Rahman et al. (2022) to examine the efficacy of Grammarly in identifying grammatical errors and enhancing writing proficiency among Malaysian students in public universities. Analysis indicates that the utilization of Grammarly software resulted in an improvement in the student's performance. The student's grade was reported as 58% before the implementation of Grammarly. The utilization of Grammarly resulted in a content score of 83% for the students' presentation. The score indicates an expansion like the writing within this item. The authors suggested that Malaysian public university students utilize Grammarly as a tool to identify grammatical problems, to enhance their writing proficiency.

In a mixed-method study, Pratama (2020) investigated students' attitudes regarding the utilization of Grammarly during the writing process. The data revealed that students held both favourable and unfavourable views on the utilization of Grammarly for essay checking. Students found Grammarly to be quite beneficial for conducting grammar and mechanics checks, encompassing aspects such as spelling and punctuation. Furthermore, students saw that the provision of feedback from Grammarly, a tool that rectifies their mistakes, significantly enhanced their self-assurance. Nevertheless, students remarked that Grammarly occasionally offers erroneous remarks, which is a disadvantage. The study conducted by Ebadi et al. (2023) examined the impact of Grammarly on the occurrence of article errors among Iranian individuals learning English as a second language. There were three distinct cohorts of students, namely experimental group 1, which received input from both Grammarly and the teacher, experimental group 2, which received information solely from Grammarly, and the control group, which received input solely from the teacher. The results of the post-test indicated that the group receiving Grammarly and teacher feedback had superior performance compared to the other groups.

The study conducted by Guo et al. (2022) investigated the relationship between user responses, namely revision procedures, and response accuracy in relation to student adoption of Grammarly feedback for error repair in research writing. The results indicate that following the change, the participants accurately addressed 85% of the Grammarly-flagged usages, resulting in a significant decrease in error ratings. The error-correction success was exceptional, considering the impact of the technical nature of study authoring on feedback accuracy and user answers, both of which are directly linked to response accuracy. Nova (2018) did a study that examined the strengths and weaknesses of Grammarly as an automated writing evaluation application in the context of academic writing evaluation. Based on the students' feedback, Grammarly offered a high level of evaluation, easy access to their accounts, helpful colour-coded comments with explanations and examples, and a complimentary service for editing academic assignments.

Despite the purported benefits, Grammarly has been found to possess many limitations, including a high occurrence of false positives, errors in accurately categorizing various forms of English and reference lists, and a restricted capability for context and content analysis. Furthermore, certain testing has indicated that Grammarly could fail to detect common writing mistakes (Pratama, 2020). Prior research on Grammarly has concentrated on the perspectives and encounters of educators and learners regarding the utilization of Grammarly. No studies have been conducted to examine the influence of Grammarly on enhancing academic reporting, such as publications. There is a notable dearth of research examining the efficacy of Grammarly in enhancing the academic writing skills of researchers and authors. This current study fills this gap in the literature.

Statement of the problem

The importance of effective research writing has been consistently highlighted in the field of Mathematics and Science Education. The research writing quality is vital in transmitting difficult concepts, knowledge dissemination, and improving understanding. Irrespective of the significance of the quality of research writing, some researchers are still saddled with numerous associated challenges. Some of the issues that hinder effective research writing are typographical errors, grammatical blunders, inadequate style, and poor clarity. Although many approaches and tools can be used to resolve these issues, the need for an efficient solution to academic writing in Mathematics and Science Education persists.

Stakeholders in Mathematics and Science Education have made notable attempts to address the challenges associated with research writing through multifarious interventions. Training workshops, conference presentations, and the utilization of applications and tools for language correction are some of the approaches implemented. Though these approaches have yielded significant improvement in isolated facets of writing advancement, there is not yet an approach or tool offering a wide-ranging solution involving the detection and correction of typographical and grammatical errors, while consistently offering insights into improving grammar, style, tone, fluency and spelling in an article. The consideration of explicit vocabulary and readability needs of researchers are lacking in most of the existing earlier studies. To plug this gap, there is a need to find an alternative approach capable of offering a more efficient and comprehensive solution to advance the quality of research writing in Mathematics and Science Education.

In light of the limitations of the earlier studies and existing worries, this study aims to investigate the utilization of the Grammarly application software package as a holistic and smart solution to improve research writing quality in Mathematics and Science Education. Thus, this study is an attempt to answer the question: How might we describe the quality of research writing in Mathematics and Science Education in terms of overall abilities (performance), vocabulary, and readability?

Aim and Objectives of the Study

This study aimed to investigate the effect of Grammarly software on the writing quality of researchers in mathematics and science education in terms of performance, readability, and vocabulary. Specifically, the objectives of the study are to:

1. Find out the difference in the writing performance scores of the researchers before and after text corrections with Grammarly application software
2. Determine the difference in the readability scores of the researchers before and after text corrections with Grammarly application software
3. Find out the difference in the vocabulary scores of the researchers before and after text corrections with Grammarly application software

Hypotheses

1. There is no significant difference in the writing performance scores of the researchers before and after text corrections with Grammarly application software
2. There is no significant difference in the readability scores of the researchers before and after text corrections with Grammarly application software
3. There is no significant difference in the vocabulary scores of the researchers before and after text corrections with Grammarly application software

Methodology

This study investigated the impact of the Grammarly application software on the writing quality of researchers contributing to a book in mathematics and science education through a quantitative research approach. The study employs a pretest-posttest approach, comparing writing scores before and after applying Grammarly grammar corrections. This study's participants include 34 researchers who contributed a total of 20 chapters to a book on mathematics and science education. Fourteen (14) of the chapters had two authors paired, while the remaining six (6) chapters had lone authors. The participants were chosen based on their participation in the book project. Grammar edits were performed on each submitted book chapter using the Grammarly program software package. For each chapter, the test scores in percentages were recorded before and after the adjustments. Furthermore, performance, reading, and vocabulary scores were recorded. The average of unique and unusual words in each chapter was used to

compute the vocabulary scores. The Grammarly program software's writing settings were set to default. The setting "Knowledgeability" was chosen for the audience to guarantee that the writing is suited to a knowledgeable audience. The formality setting was set to "Neutral" to keep the tone balanced. The domain setting was set to "General" to guarantee that the content was appropriate for various readers. The text has no clear intention. To summarize the data and test the hypotheses, descriptive statistics such as mean and standard deviation were employed. The mean scores revealed the average level of writing quality, readability, and vocabulary before and after applying Grammarly edits. The standard deviation showed the range of scores within the sample. At a significance level of 0.05, the paired-sample t-test was used to test the hypotheses. The study followed ethical norms to protect the privacy and confidentiality of the participant's data. Informed permission was sought from participants, who were informed about the objective of the study and their ability to withdraw at any time.

Results

Hypothesis 1: There is no significant difference in the writing performance scores of the researchers before and after text corrections with Grammarly application software

Table 1: Summary of descriptive statistics and paired-sample t-test on the difference in the writing performance score of the researchers before and after chapter corrections with Grammarly application software

Test score	Mean	N	SD	SEM	r	Mean	t	df	p-value	
Pair 1	P1	64.50	20	13.98	3.13	.77	-16.90	6.29	19	.00
	P2	81.40	20	2.70	.60					

Key: P₁=Pretest performance mean score, P₂=Posttest performance mean score

Table 1 displays the paired-sample statistics used to compare the mean scores of the pretest (P1) and posttest (P2). The mean pretest score was 64.50, showing the researchers' original writing performance before using Grammarly. The mean posttest score climbed dramatically to 81.40, indicating a considerable improvement in writing quality after using Grammarly. The pretest and posttest evaluations included a total of 20 book chapters. The pretest scores had a standard deviation of 13.98, showing some heterogeneity in the first writing skills. Posttest scores, on the other hand, had a smaller standard deviation of 2.70, indicating a higher level of consistency in writing performance after using Grammarly.

The standard error of the mean for pretest scores was 3.13, and 0.60 for posttest scores. These figures indicate the precision of the mean scores, with a lower standard error indicating a more credible estimate. Furthermore, the correlation value between pretest and posttest scores was 0.77, demonstrating a strong positive association between initial writing performance and improvement after using Grammarly. Also, a paired-sample t-test was performed to estimate the impact of the Grammarly software on the writing performance scores of the researchers. There was a statistically significant difference in writing performance scores before the Grammarly application (M = 64.50, SD = 13.98) and writing performance scores after content modifications with the Grammarly application (M = 81.40, SD = 2.70), $t(19) = 6.29$, $p = 0.00$. The eta squared statistic of 0.68 indicated a large effect size. Based on the findings, we reject Hypothesis 1 and conclude that there was a significant difference in writing performance scores before and after content modifications with Grammarly application software. The findings indicate that the Grammarly software has a positive impact on improving researchers' writing quality.

Hypothesis 2: There is no significant difference in the readability scores of the researchers before and after text corrections with Grammarly application software

Table 2: Summary of descriptive statistics and paired-sample t-test on the difference in the readability scores of the researchers before and after text corrections with Grammarly application software

Test score	Mean	N	SD	SEM	r	Mean	t	df	p-value	
Pair 2	R1	38.80	20	8.42	1.88	.99	0.15	0.51	19	.61
	R2	38.65	20	7.93	1.77					

Key: R₁=Pretest readability mean score, R₂=Posttest readability mean score

The results in Table 2 offer a summary of descriptive statistics and the paired-sample t-test used to analyze the difference in readability scores of researchers before and after using the Grammarly application software to edit text. The pretest's mean readability score (R1) was 38.80, showing the original readability level of the researchers' written content before using Grammarly. Similarly, the posttest mean readability score (R2) was 38.65, indicating a rather stable readability level after using Grammarly. Both the pretest and posttest examinations contained a total of 20 book chapters. The standard deviation for the pretest scores was 8.42, indicating some diversity in the participants' first writing readability levels. The posttest standard deviation was 7.93, showing a slightly decreased amount of variability in readability after using Grammarly.

The standard error of the mean for pretest scores was 1.88, while it was 1.77 for posttest scores. These figures indicate the precision of the mean scores, with a lower standard error indicating a more credible estimate. The correlation coefficient (r) between pretest and posttest readability was 0.99, indicating a strong favourable link. This shows that the participants' original readability level was extremely consistent with the readability level after using Grammarly. A paired-sample t-test was also performed to investigate the statistical significance of the difference in reading scores between the pretest and post-test. There was no statistically significant variation in readability scores before applying Grammarly text repairs ($M = 38.80$, $SD = 8.42$) and readability scores after applying Grammarly text repairs ($M = 38.65$, $SD = 7.93$), $t(19) = 0.51$, $p=0.61$. Based on the findings, we fail to reject Hypothesis 2 and conclude that there was no significant variation in readability scores before and after applying Grammarly text repairs. According to the descriptive statistics and paired-sample t-test results, the Grammarly program software had no significant impact on the readability scores of the researchers' written content. Before and after using Grammarly, the readability scores were quite consistent.

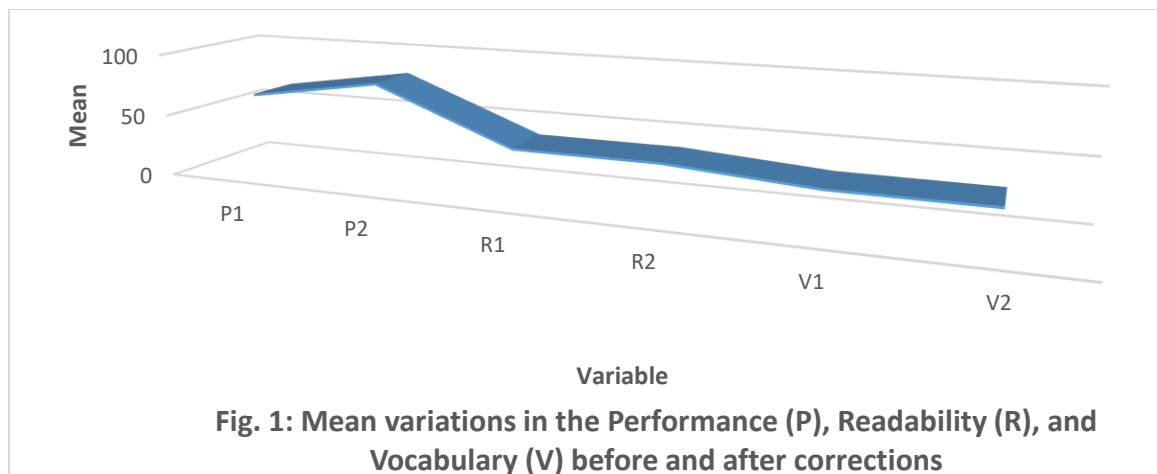
Hypothesis 3: There is no significant difference in the vocabulary scores of the researchers before and after text corrections with Grammarly application software

Table 3: Summary of descriptive statistics and paired-sample t-test on the difference in the vocabulary scores of the researchers before and after text corrections with Grammarly application software

Test score	Mean	N	SD	SEM	r	Mean	t	df	p-value	
Pair 3	V1	30.88	20	2.66	.59	.83	.30	.90	19	.38
	V2	30.56	20	2.45	.55					

Key: V_1 =Pretest vocabulary mean score, V_2 =Posttest vocabulary mean score

Table 3 shows a summary of the descriptive data and paired-sample t-test used to investigate this variation in vocabulary scores. The mean vocabulary score for the pretest (V1) was determined to be 30.88, showing the researchers' original vocabulary level before using Grammarly. Similarly, the posttest (V2) mean vocabulary score was 30.56, indicating a rather similar vocabulary level after using Grammarly. Both the pretest and posttest examinations contained a total of 20 book chapters. The standard deviation for pretest scores was 2.66, indicating some diversity in the participants' initial writing vocabulary levels. The posttest standard deviation was 2.45, demonstrating a slightly decreased amount of variability in vocabulary after using Grammarly.



The standard error of the mean for pretest scores was 0.59, while it was 0.55 for posttest scores. These figures indicate the precision of the mean scores, with a lower standard error indicating a more credible estimate. The correlation coefficient (r) between pretest and posttest vocabulary scores was 0.83, showing a significant positive link. This shows that the participants' initial vocabulary level was extremely consistent with the vocabulary level after using Grammarly. A paired-sample t-test was also performed to investigate the statistical significance of the difference in vocabulary scores between the pretest and post-test. There was no statistically significant variation in vocabulary scores before applying Grammarly text corrections ($M = 30.88$, $SD = 2.66$) and vocabulary scores after applying Grammarly text corrections ($M = 30.56$, $SD = 2.45$), $t(19) = 0.90$, $p=0.38$. Based on the findings, we fail to reject Hypothesis 3 and conclude that there was no significant difference in vocabulary scores before and after applying Grammarly text corrections. According to the descriptive statistics and paired-sample t-test results, the Grammarly application software had no significant impact on the vocabulary scores of the researchers' written content. Before and after using Grammarly, the vocabulary levels were relatively stable.

Discussion

The performance outcomes show that researchers' writing quality improved significantly after using the Grammarly application program. When compared to the pretest, the mean score for the writing performance posttest was significantly greater. This shows that Grammarly has a positive impact on improving researchers' overall writing skills. This finding is supported further by the substantial positive correlation between pretest and posttest scores, demonstrating consistent improvement across subjects. These findings contradict Hypothesis 1, which claimed that there was no significant difference in writing performance before and after using Grammarly. The results of this study support previous research conducted by Jayavalan and Razali (2018) as well as Rahman et al. (2022), which emphasize the efficacy of Grammarly in identifying writing errors and enhancing writing proficiency among individuals. The study conducted by Rahman et al. (2022) highlighted the efficacy of Grammarly in identifying grammatical errors and enhancing writing proficiency among academics. According to Rahman et al., using Grammarly software showed an increase in the students' writing performance. Consistently, Guo et al. (2022) study revealed that writers who utilized Grammarly feedback for error correction recorded a drastic decline in their error scores.

Contrary to our predictions, the reading results show no significant difference between pretest and posttest scores. After applying Grammarly text corrections, the mean readability ratings and standard deviations were pretty steady. This shows that, while Grammarly may have improved other areas of writing quality, it had no impact on boosting the readability of researchers' written content. These findings support Hypothesis 2, which expected no significant variation in readability scores. These findings contradict what Pratama's (2020) study found Grammarly to be effective in grammar and mechanics checks, including spelling and punctuation thereby improving the readability of writing reports.

The results for vocabulary show no significant variation in vocabulary scores before and after using the Grammarly program software. The mean vocabulary scores in the pretest and posttest were comparable, and the standard deviations were very consistent. The correlation coefficient indicates that there is a strong positive association between

the starting vocabulary level and the vocabulary level after using Grammarly, demonstrating consistency rather than improvement. As a result, it is possible to conclude that Grammarly had no significant impact on the researchers' language skills. These findings support Hypothesis 3, which indicated that there was no statistically significant difference in vocabulary scores. Vocabulary, according to Calma et al. (2022), was among the twelve categories of writing problems detected by Grammarly. According to Nova (2018), Grammarly offers vocabulary suggestions to support the construction of sentences in writing by way of enhancing the accuracy, clarity, engagement, and delivery of reports which somehow contradicts the study's findings. The implication is that academic editors' evaluation of the quality of the content of manuscripts for publication can be improved by using Grammarly. Also, authors of publications in English can save valuable time and boost their confidence when writing academic papers using the corrective feedback from Grammarly.

Conclusion

The purpose of this study was to investigate the effect of Grammarly software on the writing quality of researchers in mathematics and science education in terms of performance, readability, and vocabulary. Grammarly had a favourable effect on the researchers' overall writing skills, according to the data. It did not, however, result in considerable gains in reading or vocabulary. These disparate results emphasize the software's benefits in improving certain areas of writing quality while revealing limits in others. The Grammarly program software and its impact on writing quality were the topics of this investigation. Future studies can look at other writing support tools, interventions, or instructional methodologies to gain a more thorough understanding of how to improve various aspects of writing and meet the varying requirements of writers in various circumstances. Continued research and development efforts are required to refine and improve these tools, allowing people to improve their writing skills and produce high-quality written content.

Recommendations

Based on the study's findings, we made these recommendations:

1. Grammarly provides basic automated corrections, including more targeted feedback and suggestions about readability and vocabulary could help users improve their writing skills even further. This could entail creating new features or algorithms that provide personalized recommendations for improving readability and growing word usage.
2. Integrating interactive vocabulary-building exercises within the Grammarly platform by AI developers may be effective in addressing the constraints encountered in vocabulary improvement. Word games, contextual word usage exercises, and vocabulary expansion exercises suited to the user's writing demands are examples of these activities.
3. To solve readability difficulties, Grammarly or comparable tools should include writing style and tone analysis functions. These characteristics could provide insights regarding the content's clarity and coherence, assisting users in refining their writing style and adapting it to the intended audience.

Limitations of the Study

It is critical to recognize the study's limitations.

1. The study focuses on a single book project in mathematics and science education, restricting the findings' applicability to other fields.
2. The study depends exclusively on the Grammarly application software, with no consideration given to the impact of other writing support tools or interventions.
3. The absence of word count analysis may have an impact on the overall judgment of writing quality.

References

- Bai, L., & Hu, G. (2017). In the face of fallible AWE feedback: How do students respond? *Educational Psychology*, 37(1), 67–81. <https://doi.org/10.1080/01443410.2016.122327>
- Barrot, J. S. (2021). Using automated written corrective feedback in the writing classrooms: Effects on L2 writing accuracy. *Computer Assisted Language Learning*, 1–24. <https://doi.org/10.1080/09588221.2021.1936071>
- Benalileche, A., & Kaouache, S. (2021). Applying Grammarly software to correct mistakes committed by master two students in writing dissertations. *Journal of Kefaya, for Language and Literature*, 1(1), 184-195.

- Calma, A., Cotronei-Baird, V., & Chia, A. (2022). Grammarly: An instructional intervention for writing enhancement in management education. *The International Journal of Management Education*, 20(3), Article 100704 <https://doi.org/10.1016/j.ijme.2022.100704>
- Cavaleri, M., & Dianati, S. (2016). You want me to check your grammar again? The usefulness of an online grammar checker as perceived by students. *Journal of Academic Language & Learning*, 10(1), A223-A236.
- Dewi, U. (2022). Grammarly as automated writing evaluation: Its effectiveness from EFL students' perceptions. *Lingua Cultura*, 16(2), 155-161. <https://doi.org/10.21512/lc.v16i2.8315>
- Ebadi, S., Gholami, M., & Vakili, S. (2023). Investigating the effects of using Grammarly in EFL Writing: The case of articles. *Computers in the Schools*, 40(1), 85-105. <https://doi.org/10.1080/07380569.2022.2150067>
- Ghufron, M. A., & Rosyida, F. (2018). The role of Grammarly in assessing English as a Foreign Language (EFL) writing. *Lingua Cultura*, 12(4), 395-396. <https://doi.org/10.21512/lc.v12i4.458>
- Grammarly (2023a). How does Grammarly work? Retrieved from <https://support.grammarly.com/hc/en-us/articles/115000090871-How-does-Grammarly-work->
- Grammarly (2023b). What is Grammarly? Retrieved from <https://support.grammarly.com/hc/en-us/articles/115000090792-What-is-Grammarly->
- Guo, Q., Feng, R., & Hua, Y. (2022). How effectively can EFL students use automated written corrective feedback (AWCF) in research writing? *Computer Assisted Language Learning*, 35(9), 2312-2331, <https://doi.org/10.1080/09588221.2021.1879161>
- Jayavalan, K., & Razali, A. B. (2018). Effectiveness of online grammar checker to improve secondary students' English narrative essay writing. *International Research Journal of Education and Sciences (IRJES)*, 2(1), 1-6.
- Nova, M. (2018). Utilizing Grammarly in evaluating academic writing: A narrative research on EFL students' experience. *Premise: Journal of English Education and Applied Linguistics*, 7(1), 80-97.
- Nova, M., & Lukmana, I. (2018). The detected and undetected errors in automated writing evaluation program's result. *English Language and Literature International Conference*, 7(2), 120-126. <https://jurnal.unimus.ac.id/index.php/ELLIC/article/view/3501>
- O'Neill, R., & Russell, A. M. T. (2019). Stop! Grammar time: University students' perceptions of the automated feedback program Grammarly. *Australasian Journal of Educational Technology*, 35(1), 42-56. <https://doi.org/10.14742/ajet.3795>
- Perdana, I., Manullang, S. O., & Masri, F. A. (2021). Effectiveness of online Grammarly application in improving academic writing: review of experts experience. *International Journal of Social Sciences*, 4(1), 122-130. <https://doi.org/10.31295/ijss.v4n1.1444>
- Pratama, Y. D. (2020). The investigation of using Grammarly as online grammar checker in the process of writing. *English Ideas: Journal of English Language Education*, 1(1), 46-54. <https://journal.unsika.ac.id/index.php/IDEAS/article/view/4180>
- Rahman, N. A. A., Zulkornain, L. H., & Hamzah, N. H. (2022). *Exploring artificial intelligence using automated writing evaluation for writing skills*. International Virtual Colloquium on Multi-Disciplinary Research Impact (3rd Series), MEE 2.0: International Conference of Logistics and Transportation (ICLT2022), Best Western i-City Shah Alam, Selangor, Malaysia, 5-6th October, 2022. <https://doi.org/10.21834/ebpj.v7iS19.4304>
- Rao, M., Gain, A., & Bhat, S. (2019). Usage of Grammarly – Online grammar and spelling checker tool at the Health Sciences Library, Manipal Academy of Higher Education, Manipal: A Study. *Library Philosophy and Practice (ejournal)*. 2610. <https://digitalcommons.unl.edu/libphilprac/2610>
- Yousofi, R. (2022). Grammarly deployment (in)efficacy within EFL academic writing classrooms: an attitudinal report from Afghanistan. *Cogent Education*, 9(1). Article 2142446. <https://doi.org/10.1080/2331186X.2022.2142446>