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Article

Implementation of AI tools to improve English writing skills in the secondary schools in Hong Kong: Effects on student participation and writing quality

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Abstract: This study investigated the effects of AI-based tools, including Grammarly, ChatGPT, and Quillbot, on writing quality and student engagement among secondary school students in Hong Kong. The Mix method experimental design was used, whereby 100 secondary school students were randomly divided into an experimental group where they applied AI tools and a control group where they received the traditional teacher feedback. To evaluate the improvement of the quality of writing, pre- and post-intervention writing tasks were analyzed. The findings indicated that the students in the experimental group improved significantly in their writing where the mean post-test score improved by 16.2 points ($p < 0.0001$), as opposed to 4.5-point improvement by the students in the control group ($p = 0.02$). There is a higher improvement of all the writing subscales, such as grammar (6.5 points), vocabulary (4.8 points) coherence (2.9 points), and structure (2.0 points) of the experimental group. Students in the experimental group indicated an increased engagement and motivation as well, with 92 % of them saying they were more motivated to work on their writing skills than 68 percent in the control group. The results indicate that AI tools have a strong positive effect on the quality of writing, student participation, and engagement in writing activities. Nevertheless, AI tools are capable of correction on the surface, but not the depth that teacher feedback delivers. These findings indicate that AI tools can be used alongside conventional teaching models in order to create a more interactive and engaging learning process.

Keywords: artificial intelligence; writing improvement; secondary education; student engagement; AI tools; writing quality; Hong Kong education.

1. Introduction

English is among the official languages in Hong Kong but students tend to have a lot of problems with learning English especially in writing. Due to the possible lack of vocabulary and grammatical correctness, as well as the sentence structure problems, English as a second language (ESL) learners are usually unable to express ideas clearly and coherently. These are aggravated by the linguistic nature of Hong Kong that uses Cantonese which is the dominant language spoken by more than 80 % of people and this is another obstacle to learning the English language. This language distance does not only affect speech but also writing, as in most cases, the students find it hard to plan their ideas in English [1]. Second language writing requires a high level of skill and imagination which in Hong Kong is underdeveloped as the primary emphasis is put on exam scores and not in the development of innovative and reflective writing [2].

The strict educational system in Hong Kong lays much emphasis on the preparation of students to high-stakes exams, including Hong Kong Diploma of Secondary Education (HKDSE). This system concentrates on memorizing information, that is, students are trained to follow predetermined forms and styles of writing. This means that the creativity in writing is usually suppressed and students are not encouraged to spend time on the content of what they are writing [3]. The conventional method of teaching writing that is more or less summative does not give students a chance to have their iterative learning process, whereby, a student can draft a paper, revise it, and polish it with time. Students cannot be able to develop their writing skills in a holistic manner without being able to provide their writing with continuous feedback and revision. Furthermore, the abundance of demotivation and the inability to be engaged in the writing process usually results in not wanting to master the art of writing in English, which is essential to academic success and future employment opportunities [4].

Artificial intelligence (AI) has been invading a number of industries, education included, in the last several years. Artificial intelligence devices, especially those that are used to aid writing, have been lauded as a revolution to students the world over [5]. Artificial intelligence, like Grammarly, Quillbot, and ChatGPT, can transform the way students learn how to write offering immediate feedback, enhance grammatical correctness, and expand the vocabulary use. The implementation of AI in the educational process, especially in language learning, has become of great interest, especially after the COVID-19 pandemic. At this point, AI tools played an important role in the system of remote learning and gave students the resources to consume educational materials beyond the conventional classroom environment [6]. The AI tools provide individualized form of feedback, allowing students to learn at their individual speed, get real-time feedback and train on their areas of weaknesses on their own and thus are especially useful in a secondary school setting where the large class sizes might mean that teachers will be unable to provide personalized care to each student [7].

The use of AI in language learning in Hong Kong is at an introductory level. Although other schools have implemented digital tools, the effects of AI-powered tools on the quality of writing and student engagement are little researched. Current literature on AI in education tends to focus on the fact that AI can be used to improve student engagement and participation [8], and also to improve writing proficiency. Immediate corrections and suggestions are given by AI tools, and they result in the student wanting to continue with the writing process without having to wait long responses provided by teachers [9]. The tools can be used to enhance clarity, grammar, syntax, and the general structure and make the process more engaging and personalized. Nevertheless, although the potential of AI is obvious, its use and efficiency in the situation of Hong Kong secondary schools are not explored much.

The purpose of the study is to evaluate how AI-powered tools can enhance the writing of English in secondary school learners in Hong Kong. Specifically, the research will be devoted to the impact that these tools have on the student engagement in writing activities and the overall writing quality. By analyzing the application to such AI-based tools as Grammarly, ChatGPT, and Quillbot, the given paper hopes to

find the answer to the question whether these tools may bridge the gap in the writing abilities of students and enable them to be more engaged in the learning process.

The most important objectives of the study are:

- To explore the impact of AI tools on the student activity in English writing tasks.
- To identify how AI tools would impact the quality of writing of the students regarding grammar, vocabulary, coherence, and organization.
- To investigate the perceptions of students using AI tools to write and their attitude towards technology-assisted learning.
- To compare the effectiveness of AI feedback and traditional teacher feedback and student engagement.

The study is major since it responds to the increasing concern in the availability of AI tools in secondary school, especially in learning a language. Although AI tools have been successful in improving writing abilities in other settings, the influence of the tools on the students of secondary schools in Hong Kong is understudied [10]. The results of the research will reveal essential information about the potential of using the AI tools to enhance the quality of writing, improve student engagement, and engage learners when it comes to the English language learning. Moreover, the research will also help in the current debate on the use of technology in education with the practical implication to the educators and policy makers aiming at integrating AI tools in the curriculum [11].

This study will also be useful in advising future educational practices by exploring the ways AI tools may be used to facilitate the learning process of students in Hong Kong to reduce the barriers between the traditional mode of teaching and the digital innovation [12]. The findings of this paper may be used in creation of future AI-based educational tools, and also enhance teaching and learning methods in high schools.

2. Materials and methods

2.1. Research design

A randomized controlled experimental design with a mixed-method approach was used in the study to determine the impact of AI-powered tools on writing performance and student engagement of secondary school students in Hong Kong [13]. The design is the one that will use a combination of quantitative and qualitative approaches [14] to data collection to provide a thorough examination of the impact of AI tools on student performance and their experiences.

In this randomized controlled experimental design, two groups were included:

Experimental group: This group included those students who applied AI-based writing aids- Grammarly, ChatGPT, and Quillbot- to some extent during their writing. These applied real-time feedbacks, and students were able to make corrections on grammar, vocabulary, and structure of the sentences and comprehension of the entire writing.

Control group: Students of this group were provided with the traditional teacher feedback. They were doing similar writing assignments with no support of AI software and the written work was assessed in the same manner by their teachers who made corrections and suggestions by hand.

This design enabled the determination of differences in the writing performance, involvement and engagement as a result of using AI tools as compared to traditional means of providing feedback [15,16].

2.2. Participants

In this study, 100 secondary school students aged between 14 and 16 years took part in the study. The participants were chosen out of three secondary schools in Hong Kong. These schools were selected due to the fact that they were willing to implement technology in the classroom or are willing to engage in research studies.

Demographic information: The respondents belonged to different education levels and were a representative sample size of the secondary education system in Hong Kong. They were also of different degrees of proficiency in English and this made the sample representative of the general student population [17].

Group assignment: The students were randomly grouped in two groups:

Experimental group (AI-assisted): 50 students were using AI-powered tools within the period of intervention.

Control group (traditional feedback): In this group, 50 students were given teacher feedback without the use of AI tools.

All of the students and their legal guardians signed informed consent in writing before participating. The purpose of the study, the techniques that were used and the right of the students to pull out of the study at any point without any charges were well explained to the students. The study had ethics committees of the schools where it was conducted giving their ethical approval. All personal and academic data were anonymized making confidentiality one of the primary concerns during the study.

2.3. Intervention: AI tools used

Three AI-powered writing tools were used in the intervention and each of them was chosen based on its particular role in enhancing various areas of writing [18,19]:

Grammarly: This is a service that provides instant grammatical, spelling and punctuation corrections. Also, it gives recommendations on improving clarity and interest in writing by giving style and tone idea. The main advantage of Grammarly is the focus on the mechanical side of writing, meaning that learners will be able to write grammatically correct and fluent texts [20].

ChatGPT: ChatGPT is a powerful AI language model created by OpenAI and was utilized to help the students generate writing ideas, form arguments, and comment on the structure and coherence of the writing. The tool made students structure their thinking and provided the ideas of how to make the flow and sense of writing better. Conversational skills of ChatGPT also enabled the students to seek clarifications regarding writing and get instant and context-based advice [21].

Quillbot: A resource that assists in making words and sentences clearer by paraphrasing them, Quillbot offered the recommendations on how to reshape sentences and make them less predictable. It was also useful in saving the students repetitiveness and increasing their lexical inventory thereby improving the level of their writing expression [22].

Students in the experimental group used a structured workflow during writing tasks in the case of intervention. To write their essays, students first brainstormed and organized their ideas with the help of ChatGPT and then wrote them. Students engaged Grammarly after creating the first draft to determine grammatical mistakes, punctuation mistakes, and clarity. Lastly, students resorted to Quillbot in order to paraphrase sentences and enhance the presence of varied vocabulary. Such a stepwise procedure enabled students to rewrite their work severally and at the same time control the content of their essays.

The students were provided with the regular AI assignments in the English writing. The experimental group students were allowed to use these tools within six weeks when completing assignments. The tools allowed the students to revise their drafts in a cyclical manner as they were instructed to make changes basing on the feedback that the tools offered.

2.4. Data collection methods

There were two types of data collected (quantitative and qualitative) [23] in order to conduct a comprehensive analysis of the effects of AI tools on student writing. Such type of combination of data will guarantee a multidimensional picture of the impact of the intervention.

Pre-intervention writing: Students completed a brief writing task that elaborates on a topic of their choice, guided by the teacher, and assessed based on the teacher's judgment.

Pre- and post-intervention writing: Students completed a brief writing task that expounds on a topic of their choice with the assistance of the teacher and judged by the teacher [24].

Pre-intervention writing task: All the experimental and control group participants were provided with a writing task on a specific topic before the intervention took place (Appendix A). The purpose of this task was to determine their first writing proficiency in the grammar, coherence, vocabulary, and writing structure in general.

Post-intervention writing task: The two groups were given a writing task after the 6 weeks of intervention. The post-test was meant to be similar in both difficulty and subject to pre-test so that it is possible to compare the quality of the writing that was produced prior to the intervention and that which was produced after the intervention [25]. The writing activities were evaluated by the standardized rubric that was created by the language professionals (Appendix B) and special attention was paid to:

Grammar and syntax**:** Evaluating the accuracy of the applied grammatical structures.

Vocabulary: Checking the proficiency and the suitability of words used.

Coherence and organization: The measurement of the way ideas were organized and how the argument was logically developed [26].

Clarity and style: appraising the language, whether it makes sense or not and the skill of engaging the reader.

Two trained raters graded the two writing tests separately using the standardized rubric. In order to minimize the confirmation bias, the raters were unaware of the group assignment (experimental vs. control), and the timing of the test (pre-test vs. post-test).

The correlation coefficient of Pearson was used to determine inter-rater reliability and it showed a high level of agreement between the two raters (r = 0.87). Any scoring discrepancies were discussed and resolved through consensus.

Student surveys: After the intervention, a survey was given to each student. The survey included closed-ended questions (with Likert scale) and open-ended questions to describe the perceptions of students with regard to the AI tools. The significant questions examined by the survey included [27]:

- Engagement and motivation: The students will be questioned about their levels of engagement with the AI tools and asked whether the tools made them feel more interested in the writing activities.
- Usefulness: Students were asked to rate the usefulness of tools that they used to enhance their writing abilities, especially in grammar, vocabulary, and organization.
- Ease of use: Students were asked to evaluate the ease of use of the tools and the extent to which the platforms were accessible to them.

Semi-structured interviews: A semi-structured interview was conducted with the participation of a limited group of 20 students (10 students in each group). The interviews were aimed at obtaining more information about the experience of the students with the AI tools, and their views on the feedback that they obtained. The interview questions were based on [28]:

- The way the students utilized the AI tools in their writing.
- What they liked the most or did not like about the tools.
- The way their motivation towards writing and attitudes towards writing changed throughout the study.

Teacher feedback: The control group teachers gave written feedback on the writing assignments of their students. The given feedback was interpreted to investigate its rigor, promptness, and influence on the development of writing in students. The AI feedback and teacher feedback were compared which made it possible to measure the relative effectiveness of the two feedbacks [29].

Classroom observations: During the research, the observations were made to see how students played with the AI tools and how they were involved with the writing activities. Researcher recorded the level of participation of students, usage of tools as well as any problems that were encountered by students using the tools in a real classroom environment [30].

2.5. Data analysis

In order to give the firm strength of the findings, quantitative and qualitative data were assessed through the right statistical and analytic techniques.

Quantitative data:

- Pre- and post-test writing scores: Statistical tests paired t-tests were used to compare the means of the differences in quality of the writing of the two groups (experimental and control). Analysis of covariance (ANOVA) was also selected to adjust the possible differences [31], existing between the groups, before the intervention and to conclude whether the intervention resulted in statistically significant changes in writing.

- The paired-sample t-tests were used to check the progress of pre- and post-test writing scores through the use of paired samples. The analysis of variance (ANOVA) [32] was done to assess the existence of statistically significant differences between the experimental and control groups after the intervention. Besides this, the effect size was also determined through the Cohen d to determine the magnitude of the differences observed.

Survey data: Students were summarized in terms of the responses in the surveys by means of Descriptive statistics. The analysis also helped to understand the student engagement, as well as their satisfaction with the AI tools, and their perceived effectiveness.

Qualitative data:

- Thematic analysis: Interpretation of the interview transcripts was conducted with the help of thematic analysis in order to recognize the main themes concerning students' experiences with the AI tools. The thematic analysis enabled the identification of deep knowledge on the effects of the AI tools on the students with respect to the writing practice, motivation and general improvement of writing [33,34].
- Classroom observations: The data of the observations were examined to determine the interactions of the students with the AI tools, the degree of engagement, and the difficulties that students had during the writing activities.

2.6. Ethical considerations

The paper followed the best ethical practices to ensure that the rights of the participants and their confidentiality were not violated during the research process:

- Informed consent: Informed consent was received by all the students and their legal guardians. Students were advised of their right to drop out of the study any time without any penalty [35].
- Anonymity: The personal information was anonymized, and the responses of the students remained confidential. All the data were kept in a secure place so that privacy was maintained.
- Ethical approval: The Ethics committees of the schools taking part in the study provided ethical approval of the research, which saw to it that the studies were conducted according to the institutional and ethical provisions of research based on minors.

2.7. Limitations

The study design is very strong; however, it has several limitations:

- Generalizability: The study was held in three schools in Hong Kong, and, therefore, the results might not be applicable to the entire secondary schools.
- Self-Reported data: There are some data which are self-reported, especially survey and interview data, and are therefore likely to be biased or inaccurate [36].
- Limitations on the tools: AI tools are not as effective as the creative writing and critical thinking aspects can be evaluated automatically, as they are

more complicated to test with the help of the tools.

3. Results and discussion

Quantitative and qualitative data were collected throughout the intervention period [37]. The comparison of the writing performance of the students in experimental group who used AI-powered tools with the control group who got traditional teacher feedback is made in the analysis. The outcomes are devoted to the alterations in the quality of writing, interest, and perceptions of students.

3.1 Quantitative results

3.1.1 Writing performance improvement will be measured using a two-tier system

The writing activities during pre- and post-intervention were graded using a standardized rubric evaluating grammar, vocabulary and coherence and structure. The paired t-tests were used to test the differences in the writing performance of the experimental and control groups before and after the intervention.

Figure 1 demonstrated the comparison of pre-test and post-test scores of writings of the experimental and control group. They are the mean scores, standard deviations and statistical significance (p-value). The experimental group also registered a high improvement in performance in writing.

The experimental group as illustrated in **Table 1** showed the great improvement in their writing scores, where the mean score improvement was 16.2 points (p = 0.0001). Meanwhile, the control group improved by 4.5 points (p = 0.02). The statistical difference in the two groups of the improvement was significant, which means that the implementation of AI tools in writing performance was more effective than the teacher-feedback as usual.

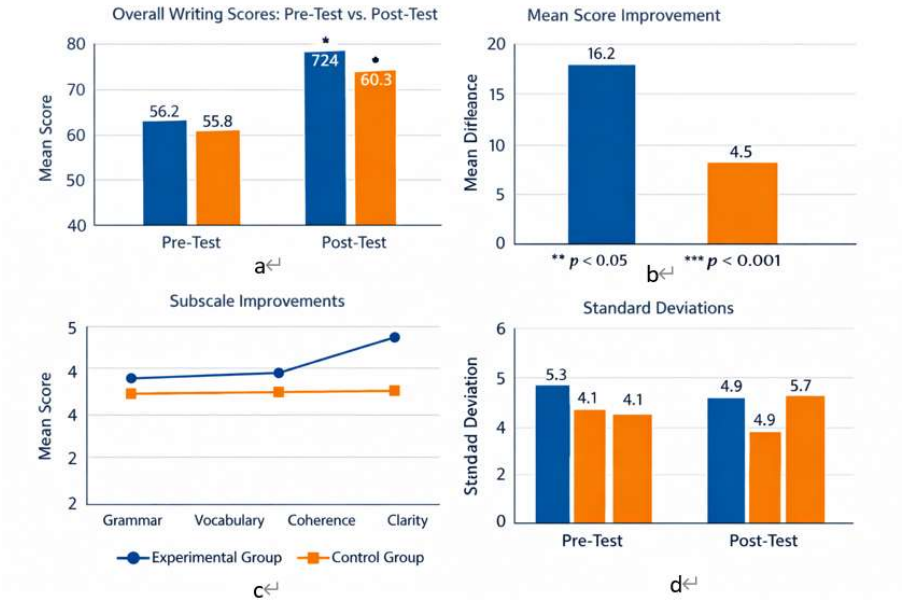

Figure 1. Comparison of writing scores and engagement for experimental and control groups: **(a)** Final writing scores in both the control and experimental group

before and after intervention, **(b)** Improved mean score pre-test and post-test between the two groups (experimental and control), **(c)** Improvements seen in the subscale writing (grammar, vocabulary, coherence, and clarity), and **(d)** SD of pre-test and post-test writing scores. The blue group (experimental condition) demonstrates strong changes in all measures in comparison to the orange condition (control group), and the changes are statistically significant (*p*-values).

Table 1. Pre- and post-test writing scores and subscale improvements.

Group	Pre-test mean score	Post-test mean score	Mean Difference (post - pre)	Standard Deviation (pre-test)	Standard Deviation (post-test)	*p*-value
Experimental group	56.2 ± 5.3	72.4 ± 4.1	16.2	5.3	4.1	0.0001
Control group	55.8 ± 4.9	60.3 ± 5.7	4.5	4.9	5.7	0.02

3.1.2 Subscale analysis of components of writing

The rubric employed to mark the writing tasks had four subscales; grammar, vocabulary, coherence, and structure. **Figure 2** shows the average changes in these subscales of the two groups. **Table 2** illustrate the better writing subscales (grammar, vocabulary, coherence, and structure) of the experimental and the control group. Experimental group demonstrated high level of improvements at the different components of writing with grammar and vocabulary being the most important ones. The p-values are statistically significant and this proves the efficacy of AI tools.

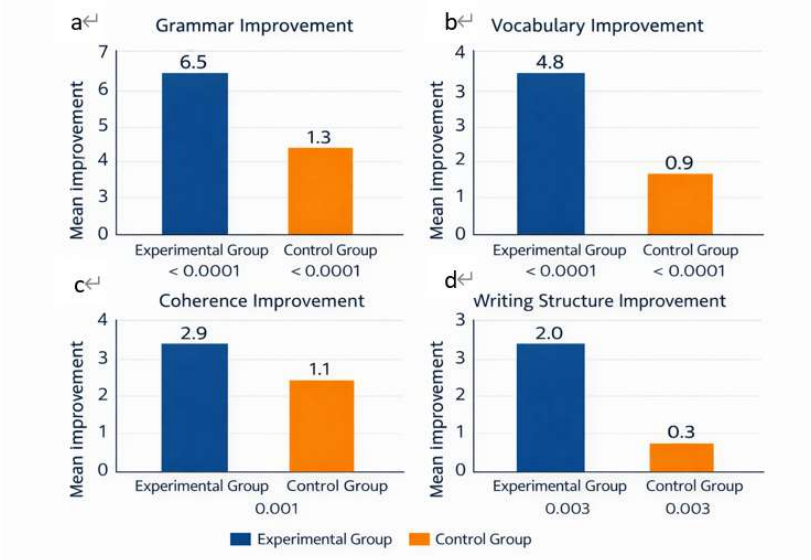

Figure 2. Comparison of writing subscale improvements between experimental and control groups; **(a)** Grammar improvement showing higher mean gains in the experimental group (6.5) compared to the control group (1.3), with strong statistical significance ($p < 0.0001$); **(b)** Vocabulary improvement indicating greater enhancement in the experimental group (4.8) versus the control group (0.9), also statistically significant ($p < 0.0001$); **(c)** Coherence improvement demonstrating higher scores for the experimental group (2.9) compared to the control group (1.1), with significant difference ($p = 0.001$); **(d)** Writing structure improvement showing notable gains in the experimental group (2.0) over the control group (0.3), with statistical significance ($p = 0.003$).

Table 2. Improvements in writing subscales.

Subscale	Experimental group mean improvement	Control group mean improvement	*p*-value
Grammar	6.5 points	1.3 points	< 0.0001
Vocabulary	4.8 points	0.9 points	< 0.0001
Coherence	2.9 points	1.1 points	0.001
Structure	2.0 points	0.3 points	0.003

All the areas were significantly improved in the experimental group, and grammar, vocabulary, coherence, and structure were all found to improve, by 6.5, 4.8, 2.9 and 2.0 points respectively. The control group however recorded little improvements in all the areas with grammar recording the highest improvement (1.3 points), vocabulary (0.9 points), coherence (1.1 points) and structure (0.3 points) respectively.

3.1.3 Student interaction and student perceptions

The results of self-reported engagement, motivation, and perceived usefulness of the AI tools in the students, offered by the experimental and control groups are summarized in the table below. The information was collected in the form of a survey that was conducted at the end of the intervention period. **Table 3** Student enactive and normative attitudes. The level of engagement, motivation, and perceived usefulness of AI tools were expressed to be substantially higher in the experimental group than the control one.

According to **Table 3** and **Figure 3**, it can be stated that the level of engagement and motivation was significantly higher in the experimental group compared to the control group. The answers indicate that the AI tools did not only make the students more engaged in the writing activities, but it also made the writing process to be more dynamic and interactive. Specifically:

- The writing task was also more engaging to 85% of the students in experimental group compared to 30% of control group.
- The rate of motivation to better their writing was 92% as compared to the control group which was 24% higher.

Table 3. Student engagement and perceptions of ai tools.

Survey item	Experimental group (%)	Control group (%)	*p*-value
Found the writing task more engaging	85	55	< 0.0001
Felt motivated to improve writing skills	92	68	< 0.0001
Found the AI tools useful for improving writing	87	N/A	N/A
Preferred AI feedback over teacher feedback	80	N/A	N/A

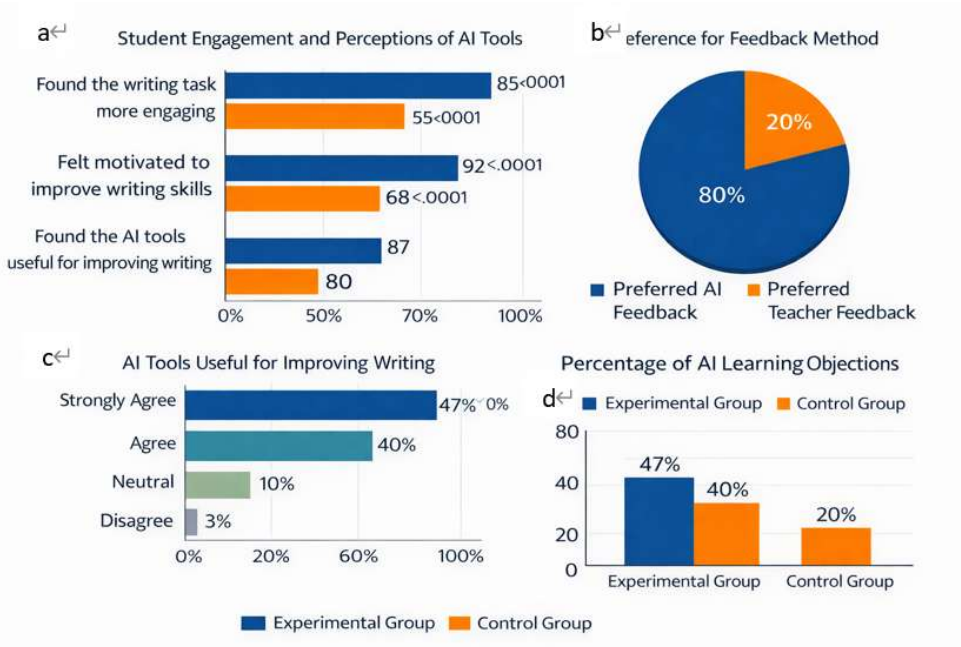

Figure 3. Student interaction and perceptions of AI tools in writing tasks; **(a)** Comparison of student engagement and motivation levels showing higher percentages in the experimental group (85% found tasks more engaging, 92% felt motivated, 87% found AI useful) compared to the control group (55%, 68%, and 80% respectively), with statistically significant differences ($p < 0.0001$); **(b)** Preference for feedback method indicating that 80% of students preferred AI-based feedback while 20% preferred teacher feedback; **(c)** Students' ratings of AI tools usefulness showing high agreement levels (47% strongly agree, 40% agree) with minimal disagreement (3%), reflecting positive perceptions toward AI tools; **(d)** Percentage of AI learning objections illustrating that the experimental group (47%) reported more objections compared to the control group (40% and 20%), suggesting a more complex engagement with AI tools despite overall positive outcomes.

Moreover, the experimental group was more satisfied with the writing process, as 87 per cent of the respondents began to appreciate the AI tools as helpful to enhance their writing and 80 percent of the respondents developed more positive appreciation of the instant feedback that the AI tools could offer compared to their traditional teacher feedback [38].

The control group, in its turn, was less engaged and motivated, which may indicate that, although traditional feedback remains a useful tool, AI tools provide a more timely and individualized means of enhancing writing skills.

3.2 Qualitative results

3.2.1 Interview feedback of students

To get a more insight into how students use AI tools, semi-structured interviews were organized with a smaller group of 20 students (10 in each group). In the experimental group, students stated that their experience with the AI tools was positive, and similar themes have been identified through analysis of the interviews [39]:

- Instant feedback: The students liked getting real-time feedback. A student

has mentioned that with Grammarly, I do not need to wait many days before the teacher can provide feedback. I can improve right away."

- improved writing confidence: Students said that they felt more confident in the writing process as they were able to notice improvement. According to another student, the use of ChatGPT made me organize my ideas, therefore I felt more confident about doing the writing.
- Writing quality: A significant number of students have confirmed that the quality of their writing, especially regarding grammar and vocabulary, improved. One of the students in the experimental group said that he/she has used Quillbot to learn new words and therefore has made his writing sound more professional.
- Conversely, the students who belonged to the control group reported that teacher feedback was beneficial to them, although they believed that the feedback was usually provided late and could not enable them to make real time corrections. One of the students told me that the feedback given by the teacher is helpful but this is already too late to change in the same assignment. Under AI, I would be able to correct things immediately.

3.2.2 Teacher feedback regarding the intervention

Teachers who took part in the research gave comments on the efficacy of AI tools used against the traditional feedback. They admitted that the AI tools did provide direct corrections and were helpful in fixing simple grammar and spelling errors, but they believed that the AI tools could not be as informative and as personalized as they could be. According to one of the teachers, AI software is excellent at making superficial corrections, but it fails to tackle the creativity and quality of the content that I can talk about with students in depth.

Nevertheless, educators admitted that AI applications can be a powerful auxiliary tool, in particular, to receive immediate feedback on drafts and enable students to self-correct their final work before submitting the work.

4. Discussion

The study findings suggest that AI-based tools are positively influential in the writing performance, engagement, and perceptions of the students to a large extent. The experimental group demonstrated significant improvement in quality of writing especially in grammar, vocabulary and coherence. This insight is aligned with previous studies indicating that AI tools have the potential to enhance the level of writing skills, offering feedback as it is being written, and the feedback is specific [40].

One intriguing trend that was identified with the results was the fact that the standard deviation of the experimental group decreased by 5.3 during pre-test and 4.1 during the post-test. The decrease indicates that the AI tools might have led to the more stable writing performance in the students. The tools may have standardized parts of the writing process, especially grammatical correctness and structure of sentences, causing a lower range in the performance of the students. Although such consistency has the benefit of enhancing the accuracy of technical writing, further research is necessary on whether the heavy application of AI tools can have an effect

on the stylistic variation of student writing.

The remarkable increase in the writing scores in the experimental group is explained by the fact that real-time feedback provided by the AI tools is significant. These aids helped the students to take an active role in the writing process providing them with instant corrections and suggestions that triggered revision and improving the process. Moreover, the association of the overall engagement and motivation of the students in the experimental group being high reflects the fact that AI tools help to make writing process more interactive and less overloaded with the traditional approach [41].

The fact that the students highlight the positive aspect of the AI tools when it comes to their usability and engagement proves that the tools not only allowed to enhance the quality of the writing but also made the process of writing more interesting and encouraging. This would indicate that AI tools may be an efficient complement to conventional writing teaching and, specifically, in the setting where it is challenging to provide immediate feedback because of large classes [42].

Nevertheless, the article also mentions that the use of AI also has its limits. Although they are very effective in delivering a superficial level of corrections, they might not be effective in addressing more intricate elements of writing like creativity and critical thinking. Hence, AI-assisted teacher feedback may be balanced in the use of AI and conventional approaches to the language learning process by utilizing the merits of both solutions.

5. Conclusion

The research question of the study was to determine how AI-driven tools the following tools can enhance the quality of writing and engagement among secondary school students in Hong Kong, Grammarly, ChatGPT and Quillbot. The findings of this mixed Method study are convincing in the sense that application of AI tools led to tremendous improvement in the performance of students in regards to their writing, especially in the aspects of grammar, vocabulary, coherence, and structure. The experimental group that used AI tools showed an extremely significant improvement in writing abilities in comparison with the control group that used traditional teacher feedback.

The main conclusions of the current paper are the following:

- Writing performance: The students in the experimental group demonstrated significant statistical change in their writing tasks and the writing quality was significantly better, in particular, grammar and vocabulary. The immediate response that AI tools gave the students enabled students to edit and polish their writing better than other conventional ways.
- Engagement and motivation: Student engagement and motivation were the significant effects of the integration of AI tools. Learners have reported to feel stronger and in control of the writing process and can make instant corrections and improvements. The writing process was made less challenging and more interactive with the help of the AI tools.
- Student perceptions: Students in the experimental group generally felt that the AI tools were helpful and having a user-friendly interface, and many

students said that they preferred AI feedback to teacher feedback. It means that AI tools could be used as an addition to conventional teaching and assist learners in studying independently.

- Teacher feedback: Although the use of AI tools was effective in correcting the surface-level issues, teachers admitted that personalized feedback they offer is not replaced by these tools. Nevertheless, AI-based tools may also be a valuable auxiliary tool, especially in the case of immediate feedback and self-directed learning.
- Although the results were promising, the study has also noted a number of limitations such as the small sample size and the possibilities of biases in self-reporting survey and interview information. In addition, AI-based tools are generally good at enhancing the rudimentary writing skills, whereas they might not cover more subjective writing aspects, including creativity and critical thinking. The next line of investigation should be how AI tools may be used in traditional teaching to create a more comprehensive way of learning the language, which incorporates both technical and creative sides of writing.
- Practical and future research implications: According to this study, AI tools can help with secondary education and be useful in developing writing skills and making students more engaged. Since the use of digital learning tools is increased, the introduction of AI into the classroom may offer the students a more personalized [43], effective, and interactive learning experience. Nevertheless, the critical point is that it is necessary that the AI tools should be used by educators to enhance the conventional teaching cycle but not to substitute it. Future research may concentrate on longer-term interventions, whether AI tools can be applied in other areas of language learning, and whether AI can be used to solve more complicated writing problems including creativity and argumentation.

To sum up, AI-based tools are an encouraging direction of writing education process improvement in the secondary schools of Hong Kong. Through instant feedback, the encouragement of independent learning, and the improvement of student motivation, AI applications can help in the process of learning how to write, which will eventually lead to the improved academic performance and more active learners.

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Appendix A

Table A1. Example writing task.

Item	Description
Task type	Short essay writing
Word limit	Approximately 200–250 words
Instructions	Students were asked to write a short essay responding to the prompt and provide relevant examples to support their ideas.
Writing prompt	*"Discuss how technology can improve education for secondary school students. Provide examples to support your ideas."*
Purpose of task	To assess students' writing ability, including grammar, vocabulary, organization, and clarity of ideas.

Appendix B

Table B1. Writing assessment rubric.

Component	Score Range	Description
Grammar and syntax	0–25	Accuracy of grammatical structures, correct sentence construction, and proper use of punctuation.
Vocabulary use	0–25	Variety, appropriateness, and correct usage of vocabulary in expressing ideas.
Coherence and organization	0–25	Logical flow of ideas, effective paragraph structure, and clear connections between sentences and paragraphs.
Clarity and style	0–25	Clarity of expression, readability, and effectiveness in communicating ideas to the reader.
Total score	0–100	Combined score of all four components representing overall writing quality.