Mind mapping software to aid academic writing: Pre-service English language teachers using i-Think maps

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Academic writing is a key determinant to be successful in higher education institutions, and graduation requirements often involve students producing theses and dissertations using academic writing skills after conducting research. The COVID-19 pandemic has greatly affected pre-service teachers' learning in higher education institutions, and with the continued existence of problems in both writing and academic writing, this research investigates mind mapping software to aid pre-service teachers in writing academically. It aims to determine whether *i-Think* maps through software help pre-service teachers to perform academic writing, and explores their perceptions of learning academic writing with this software. Sequential explanatory mixed methods were used where single-subject experiments and online interviews were employed. Twenty pre-service teachers from a private university in Malaysia have participated in the research. Findings show that pre-service teachers experienced significant improvement in academic writing after *i-Think* maps and software were introduced; the pre-service teachers interviewed generally agreed that the software incorporating *i-Think* maps is useful for learning academic writing, and academic writing is a skill that must be mastered throughout the study. Practical and clinical suggestions related to academic writing and the findings obtained are provided.

Introduction

The happening of COVID-19 pandemic is no longer a stranger to Malaysians and the globe at large. Following the declaration of a pandemic by the World Health Organization (n.d.) and with the rise of infection cases in Malaysia, the Malaysian government had since implemented the Movement Control Order (MCO) throughout the nation (Azman & Abdullah, 2021; Harun, 2020; Malaysia Ministry of Health, 2020; Shahzad et al., 2020; Zolkepli, 2020). Schools nationwide were forced to close down to ensure the safety of students and in response to this, all public and private higher education institutions (HEIs) had also arranged to send the university students back to their respective homes and physical, face-to-face mode of learning shifted to online learning (Azman & Abdullah, 2021; Shahzad et al., 2020). Teacher education programs conducted by HEIs (Phang et al., 2021) were forced to close down temporarily as well. To date, prominent online learning platforms that are widely used in Malaysia are *Google Classroom*, *Microsoft Teams*, and *Zoom* (Shahzad et al., 2020).

COVID-19 itself has led to negative consequences in learning. Undoubtedly, one of the major problems is that Malaysian university students' learning experience is greatly affected. Shahzad et al. (2020) found that university students are thrust with several difficulties during the shift from physical classes to online classes. While the shift is welcomed by all parties in HEIs, the quality and impact of learning are major concerns (Shahzad et al., 2020). Further, Azman and Abdullah (2021) mentioned several concerns faced by university students who are attending online classes: (1) quality of education

received; (2) preference for physical classes over online classes; (3) access to university facilities; and (4) value of money invested to obtain an education.

Academic wise, several problems exist in Malaysian HEIs. Mainly, both writing and academic writing among university students have long been a concern in Malaysia. As assignments along with dissertations and theses are important elements to be completed in HEIs, many undergraduates and postgraduates are experiencing much stress when it comes to writing (Akhtar et al., 2019; Al-Zubaidi, 2012; Musa et al., 2012; Singh, 2015; Sovakandan et al., 2017). Akhtar et al. (2019) and Swaran et al. (2020) highlighted that university students do not possess sufficient writing proficiency and academic writing skills. The situation becomes dire as many university students are also found as lacking capabilities in higher-order thinking skills (HOTS) (Akhtar et al., 2019; Al-Zubaidi, 2012; Singh, 2015; Sovakandan et al., 2017). Finally, despite the Malaysian Ministry of Education (MOE, 2013; 2015) having emphasised the importance of research and academic writing, and HEIs often focusing on research writing (Al-Zubaidi, 2012; Singh, 2015), Phang et al. (2021) found that literature on teacher education frequently looks into these topics as challenges faced by pre-service teachers in teaching practicum. However, as Phang et al. (2021) concentrated upon mentoring experiences in teaching practicum, there is still little research into the academic writing needs of pre-service teachers.

Addressing the aforementioned problems, this research sought to achieve the following research objectives: (1) to determine if mind mapping software helped pre-service teachers in academic writing, and (2) to explore the pre-service teachers' perceptions of using the software in academic writing. A set of hypotheses was established to answer the first research objective, where H_0 indicated no significant difference between pre and post-tests while H_1 indicated a significant difference detected. As an overview, this research used a sequential explanatory mixed-method, involving single-subject intervention experiment and online interviews.

Literature review

Given its historical context, the English language has long maintained its status as a second language in Malaysia (Akhtar et al., 2019; Maarof & Munusamy, 2015; Musa et al., 2012; Singh, 2015; Yunus et al., 2013), where the language is learnt mainly through classroom instruction and teaching. English language writing is frequently treated as one of the most important skills that users must master (Akhtar et al., 2019; Karim et al., 2016; Singh, 2015). Generally, writing is defined as expressing ideas, thoughts, and contents that are meaningful on pieces of writing through a set of defined symbols and mechanics (Karim et al., 2016). The process of writing is highly complex as generally it involves much cognitive processing and HOTS when organising pieces of content into coherent paragraphs (Sovakandan et al., 2017). As students continue to pursue higher education, they encounter wider use of English language in courses of study, often mainly in the form of written assignments (Akhtar et al., 2019; Kee & Razali, 2019; Sovakandan et al., 2017; Yunus et al., 2013).

Teacher education and academic writing

In HEIs, MOE has recognised the importance of academics and research in raising the quality of higher education and attaining higher rankings in the world of academia (MOE, 2015). Within the Malaysian Education Blueprint (MEB) specifically designed for higher education, MOE (2015) has stated aims that include increasing the number of publications by three-fold and citations by four-fold. Also in the blueprint for Malaysian HEIs, MOE seeks to advance higher in prominent university rankings such as the *QS World University Rankings*, *Shanghai Academic Ranking of World Universities*, and the *Times Higher Education World University Rankings*, subsequently achieving the following aspirations for students:

> The Ministry of Education will continue to use the National Education Philosophy's vision of a balanced education as its foundation for individual student aspirations. The preschool, primary, secondary, and higher education systems share a vision of what the outcome of a Malaysian education should look like, and what that means for individual students. The Ministry emphasises the balance between both knowledge and skills (*ilmu*) as well as ethics and morality (*akhlak*). The student aspirations in the MEB are built around six primary attributes: ethics and spirituality, leadership skills, national identity, language proficiency, thinking skills, and knowledge. These are the same six attributes for students that the higher education system is anchored on (p.I-9).

Teacher education programs in Malaysia have come a long way since the establishment of the very first teacher training college in 1957 (Vethamani, 2011). Today, Institutes of Teacher Education (*Institut Pendidikan Guru*) and Universiti Pendidikan Sultan Idris (UPSI) are platforms for teacher education and offering degree qualifications in teaching after pre-service teachers have completed their course of studies and attended teaching practicum (Phang et al., 2021; Vethamani, 2011), rendering these institutions as Malaysian HEIs. Currently, in the Malaysian education blueprint, contemporary teachers are expected to possess pedagogical skills suitable for 21st-century teaching and learning, and also demonstrate researching and academic writing skills and be able to make scholarly presentations related to education (MOE, 2013; 2015).

Hence, one of the requirements to graduate from teacher education programs, as many Malaysian HEIs specify, is that pre-service teachers conduct research and produce theses (Al-Zubaidi, 2012; MOE, 2013; 2015; Singh, 2015). This means that pre-service teachers must possess academic writing skills before engaging in this activity (Akhtar et al., 2019; Al-Zubaidi, 2012; Singh, 2015). Akhtar et al. (2019) have previously defined academic writing as a form of scholarly writing involving complex and dynamic procedures where writers have to connect, synthesise, develop, argue, and demonstrate knowledge of a subject. As academic writing is one of the key determinants of being a successful student in university (Al-Zubaidi, 2012; Singh, 2015), this form of writing is a literacy task that must be mastered along with researching skills through formal instructions in HEIs (Akhtar et al., 2019; Al-Zubaidi, 2012; Singh, 2015; Yunus et al., 2013). The knowledge and skills of research and academic writing are not wasted at the end of the course of study, as teachers need to continue perform educational research and action research that aims to continue improving the state of education (Creswell, 2014; Creswell & Guetterman, 2019; Norasmah & Chia, 2016).

Hyerle's *i-Think maps*

Developed by Hyerle and Yeager in 2007, *i-Think Maps* serve as visual tools to stimulate and develop HOTS among students (Costa & Kallick, 2008; Hamzah & Wan Yusoff, 2021; Sovakandan et al., 2017; Swaran et al., 2020; Yaakub et al., 2018). The use of i-Think Maps also helps in developing and branching abstract ideas that are essential in innovative thinking (Erdem, 2017; Hamzah & Wan Yusoff, 2021; Swaran, 2020). As i-Think Maps are easy to construct, users can design the maps easily and freely to fit their ideas in during their learning (Costa & Kallick, 2008; Sovakandan et al., 2017). Using mind maps conforms with constructive approaches to learning, where users experience continuous active learning by generating blocks after blocks of knowledge and ideas in the process (Erdem, 2017). A total of eight different types of i-Think Maps were introduced by Hyerle, including *Brace Map, Bridge Map, Bubble Map, Circle Map, Double Bubble Map, Flow Map, Multi-Flow Map*, and *Tree Map* (Hamzah & Wan Yusoff, 2021; Swaran et al., 2020; Yaakub et al., 2018). An example of a r*Edraw*n Bubble Map and Flow Map from Hyerle's i-Think Maps by the researchers is as shown in Figure 1.
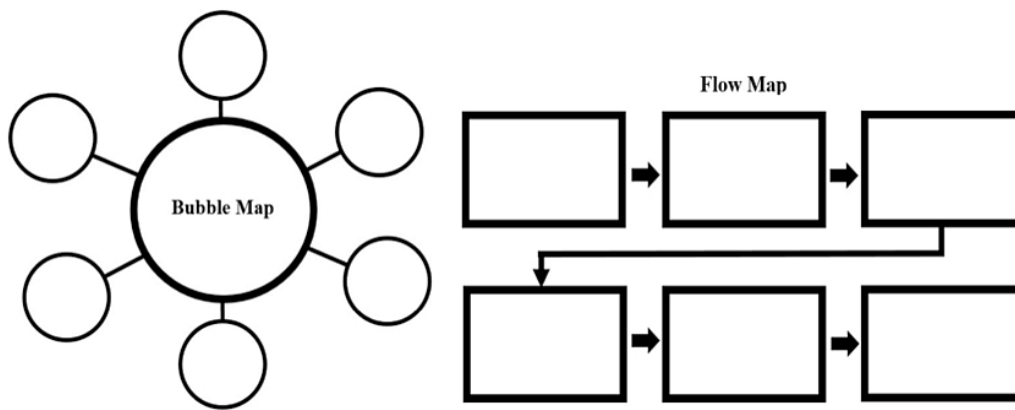

Figure 1: Bubble map and flow map

Through a collaboration with the Malaysian Innovation Agency, MOE has introduced and launched the *i-Think Program* to engage teachers and students during classroom teaching and learning (Hamzah & Wan Yusoff, 2021; Sovakandan et al., 2017; Swaran et al., 2020; Yaakub et al., 2018). Further, as part of the Malaysian Education Development Plan, MOE aspires to have students be well-equipped with HOTS where they can think analytically, critically, creatively, and independently throughout lessons (Swaran et al., 2020; Yaakub et al., 2018). As mentioned earlier, since university students are required to be actively involved in academic writing which demands HOTS, i-Think Maps are one method to help students visualise their ideas and help to develop quality writing (Swaran et al., 2020). These maps further train university students to think wisely when managing and organising their ideas before producing writing a paper (Hamzah & Wan Yusoff, 2021). Furthermore, these skills are considered essential as contemporary workplace employment, regardless of fields, requires employees to demonstrate them in solving

various issues and problems that may occur in the workplace (MOE, 2013; 2015; Tiew & Abdullah, 2019).

Even though i-Think Maps are currently implemented in primary and secondary education throughout Malaysia (Hamzah & Wan Yusoff, 2021; Sovakandan et al., 2017), university students may benefit from renewed exposure, especially in relation to handling assignments and writing theses. Currently, due to the COVID-19 pandemic learning has shifted from traditional, face-to-face classes to online classes (Azman & Abdullah, 2021; Harun, 2020; Shahzad et al., 2020). Classes today require a great deal of information technology (IT) and other modern equipment (Grapragasem et al., 2014; Shahzad et al., 2020). Using i-Think Maps can be done through information technology, where *Edraw*, a software developing company has developed the *MindMaster* software that allows users to create maps (*Edraw*, 2020).

Edraw **software**

As introduced by *Edraw* (2020), this software is a tool to do mind mapping and brainstorming for idea presentation according to different purposes. The purposes of using this software may be for planning projects, strategic analysing of data, and managing products. Within the software, users of *Edraw* may customise their ideas using different kinds of maps, colours, animation, styles, and images, according to personal preferences. The choices of maps are presented in the forms of templates where users may choose whichever they desire to initiate their work. These templates are available upon launching the software as shown in Figure 2.
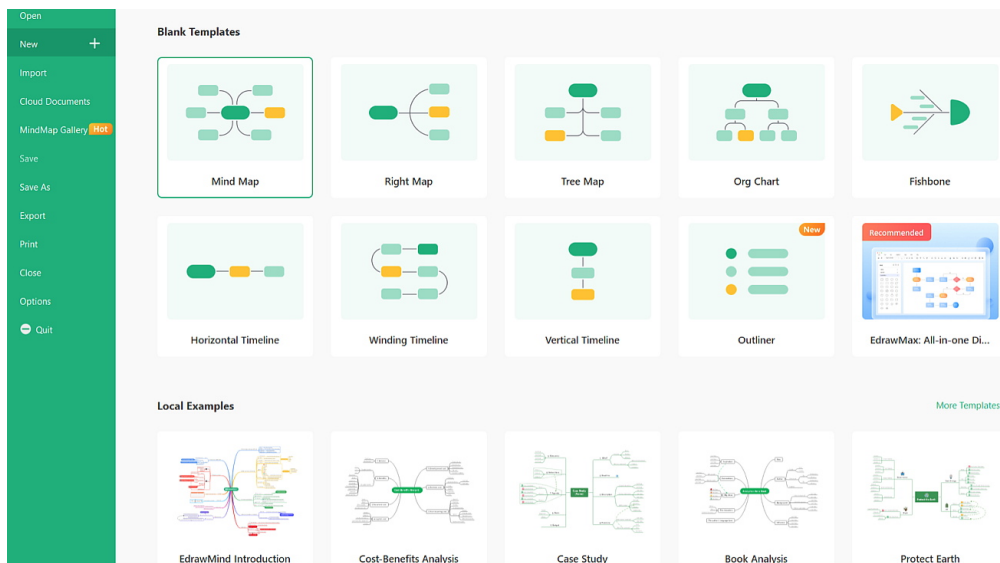

Figure 2: Templates available in *Edraw*
(use "zoom in function in PDF reader, or see
Appendices: Accessing high resolution Figures 2 and 3)

Further, this software allows all works to be easily presented to others, for editing and collaboration purposes, though full control and permissions are kept within the original author's parameters. As such, for collaboration purposes the access to the software transcends geographical and time aspects. Simply, any projects done through *Edraw* software can be presented anytime, anywhere. The software is available in all technological platforms including Android, iOS, Mac, Linux, and web servers. A view of the *Edraw* interface is as shown in Figure 3.
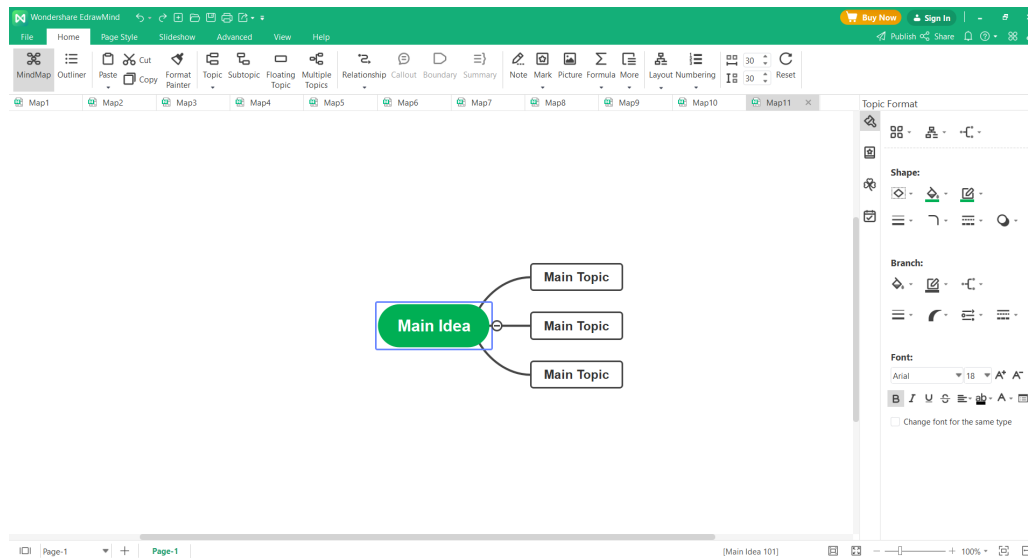

Figure 3: *Edraw* user interface
(use "zoom in function in PDF reader, or see
Appendices: Accessing high resolution Figures 2 and 3)

From the user interface shown, it can be seen that the functions available are quite similar to functions in software provided by Microsoft *Office*, especially in Microsoft *PowerPoint* and Microsoft *Word*. Users can customise maps into different levels of topics and incorporate mathematical formulae, images, and layout when designing the maps; the Page Format on the right of the screen allows users to generate interesting backgrounds through themes and effects. Additionally, within the same column the user may save the project in the form of task by setting the time and description. While the maps can be drawn single-handedly by any user on Microsoft Word, drawing from scratch may be time consuming and there is a possibility that the user does not have any idea how to start designing the map. The templates shown in Figure 2 can greatly reduce the time needed for deciding on a design, and projects can begin quickly. Although *Edraw* may require users to make a purchase of three different plans for education, with 2-Year Plan, Annual Plan, and Semi-Annual Plan respectively, the templates as shown in Figure 2 are sufficient for users to create projects for learning. Students and teachers may simply access the main website (https://www.*Edraw*soft.com/) to download the software for learning, at any geographical location and time, even amidst the COVID-19 pandemic.

Using technology to achieve education is often via a learning management system (LMS) in many educational institutions, which can be viewed as an progressive way to improve teaching and learning quality (Alfahad, 2012; AlAmmary, 2012). As students interact with the technology in educational institutions, the impact of learning increases where they get to experience a boost in self-confidence, increase in technology competency, and become creative in generating ideas (AlAmmary, 2012). The use of educational technology can reduce reliance upon learning in a traditional manner, as students practise actively constructing knowledge in their learning (Erdem, 2017). As aforementioned, academic writing is a complex and tedious skill to be mastered (Akhtar et al., 2019; Al-Zubaidi, 2012; Singh, 2015). It is thus inferable that educational technology such as *Edraw* could help creating an impact when integrated into learning academic writing (AlAmmary, 2012; Alfahad, 2012).

To summarise from the literature review, since i-Think Maps has been implemented in mainly in primary and secondary education in Malaysia, what remains little known is the value of these maps for university students and therefore, a need arises to research this topic.

Research method

A sequential, explanatory mixed-method design was used to conduct the research, wherein this design typically begins with a quantitative inquiry, followed up with qualitative inquiry (Creswell, 2014; Creswell & Guetterman, 2019; Edmonds & Kennedy, 2017; Phang et al., 2021). In the quantitative inquiry, a single-subject experimental method was implemented and the findings from the experiment were followed up by the qualitative inquiry, which was online interviews. Single-subject experiments are experiments that specifically look at the effects of the intervention introduced within an individual or group, which means the sample size can be reasonably small (Creswell, 2014; Creswell & Guetterman, 2019; Edmonds & Kennedy, 2017). Online interviews are interviews that are conducted through virtual platforms, in which both interviewer and interviewee interact through audio and visual functions that are available regardless of geographical location and time (Creswell, 2014; Creswell & Guetterman, 2019; Edmonds & Kennedy, 2017). As the research was conducted amidst the pandemic and campus closures, Microsoft *Teams* was chosen as the main platform for conducting both experiments and interviews, it being physically impossible for the researchers and participants to meet.

Samples

The research was conducted in a private HEI located in the state of Perak, Malaysia, that offers teacher education programs to students seeking to become English language teachers. However, the HEI's name is not revealed, in accord with conditions specified in Faculty approval for conducting the research. To achieve the research objectives, pre-service teachers who were in their final year of study were recruited. Prior to reaching the final year, they were required to study the subjects *Academic Writing* and *Research Methodology*, available during the first and second year of study respectively. Further, the pre-service teachers who were sampled were required to produce dissertations as part of

graduation requirements, and as Al-Zubaidi (2012) and Singh (2015) have mentioned, dissertation writing involves essential skills in academic writing. A total of 32 final-year pre-service teachers was identified and recruited through student emails.

Duration of conducting the research

The research was conducted for six weeks in 2020, situated in the short trimester that fell between October and December. Specifically, at the end of October 2020, the pre-test was conducted, followed by four weeks of intervention, one time a week throughout November 2020. At the fourth week of intervention, the post-test was conducted. The intervention was conducted only once per week as the pre-service teachers had other lectures and tutorials to attend, and the researcher had to accommodate to their schedule. Finally, on the sixth week which fell in December 2020, interviews were conducted.

Data collection and analysis

Throughout the research, English language was used as the main form of communication. To justify, the pre-service teachers were future English language teachers and English is the main means of communication in most HEIs (Koh et al., 2019), though some subjects (e.g., *Hubungan Etnik* or ethnic relations) are conducted in the national language, Malay. The research began with quantitative data collection and was then followed by qualitative inquiries. In the single-subject experiment, after consulting a Faculty lecturer an argumentative essay with the topic "Rationale of studying the English language" was chosen as the pre and post-test for the pre-service teachers to attempt. The researchers then scheduled a time with all who had agreed to participate in the research to meet on Microsoft Teams, without knowing the topic of the argumentative essay. The topic was announced to all at the same time and they were given 45 minutes to produce argumentative essays. These essays were submitted to the researchers as PDF files at the end of the 45 minutes.

Both pre and post-tests argumentative essays were marked based on the rubric provided by a lecturer who has taught the subject Academic Writing previously. While the full rubric was requested by the faculty as not to be released, the rubric contains three aspects to mark the essays: (1) mechanics, (2) use of evidence, thesis, and claims, and (3) presentation of critical analysis. To summarise from the rubric, mechanics is described as writing that is cohesive, organised, and has a concluding statement that addresses the arguments introduced. Use of evidence, thesis, and claims is described as information, facts and details presented that are significant in provoking thoughts. Presentation of critical analysis is described as providing claims that are evidenced and relevant in supporting the information presented. Further, as the purpose was to determine if *Edraw* helped in pre-service teachers' academic writing, no form of feedback was given to them at the end of the pre-test, to help ensure authenticity of the essays produced in the post-test after experiencing *Edraw*.

Each aspect was weighted 10%, and the highest possible score was 30%; the score obtained would be converted to 100% as the final result. The formula to calculate the score was:

$$\frac{(Mechanics) + (Evidence, thesis, and\ claims) + (Critical\ analysis)}{30} \times 100\% = Final\ score$$

Each argumentative essay was marked twice by the researchers individually to minimise potential bias. Such a method of marking the essays is a form of inter-rater reliability, where the validity of results is achieved through two reviewers (Creswell & Guetterman, 2019; Edmonds & Kennedy, 2017). A Faculty lecturer was also requested to check on the scores given for further validation. The results were all recorded in *SPSS Version 25* and were analysed using descriptive statistics and a paired *t*-test since it involved the same group.

After conducting the pre-test, the researchers held four meetings on Microsoft Teams for four days in a month and introduced the *Edraw* software to the pre-service teachers. As *Edraw* software is not available in the HEI, the researchers introduced and taught the procedures for independent personal access to the software. Each meeting lasted 30 to 40 minutes wherein the researchers briefed and guided the pre-service teachers to install and use the *Edraw* software. Hyerle's i-Think Maps were also illustrated to the pre-service teachers using this software. On the fourth day of the intervention, the post-test was conducted using the same argumentative essay topic.

Then, six pre-service teachers who had sat through the tests were interviewed through Microsoft Teams. A set of interview questions based on the research objectives and literature was devised and previously piloted with two pre-service teachers. The piloted interview questions helped in minimising potential confusions that might occur, such as ambiguous meaning and language use and the use of jargons (Castillo-Montoya, 2016; Creswell & Guetterman, 2019). The researchers had also devised an interview protocol addressing the list of main and sub-questions to be asked along with prompts and probes. The interview protocol served to ensure there was a systematic flow of interviews so that both interviewers and interviewees would not be confused throughout the interview (Creswell & Guetterman, 2019). All interview sessions were recorded with consent from the pre-service teachers, transcribed, and coded to generate themes to explain the test scores obtained in the experiment.

Findings and discussion

Among the 32 final-year pre-service teachers contacted, 20 volunteered to participate. Thirteen pre-service teachers were females (65%) and seven were males (35%). Further, 15 were Chinese (75%) and five were Indian (25%). Each pre-service teacher was assigned a pseudonym to ensure confidentiality and minimise bias (Creswell, 2014; Creswell & Guetterman, 2019).

Table 1 displays the descriptive statistics obtained for both tests. From the descriptive statistics, there seemed to be a slight improvement between pre and post-tests. The mean score increased from 21.1 to 24.4, and average word count showed a slight increase from 574 words to 576 words. In the pre-test, word counts ranged from 369 to 820; and in the post-test the word count range was 389 to was 831.

Table 1: Descriptive statistics for both tests (N=20)

	Mean	Lowest score	Highest score	Standard deviation	Average word count
Pre-test	21.1	17	25	2.713	574.55
Post-test	24.4	22	27	1.226	576.10

Table 2 presents the mean scores for the three aspects used to mark the argumentative essays. While the Use of evidence, thesis and claims, as well as Presentation of critical analysis showed some improvement, the means for Mechanics were low and even declined by .05 in the post-test. Clearly, the pre-service teachers were performing poorly in terms of Mechanics and this must be addressed.

Table 2: Mean scores of aspects marked for both tests (N=20)

	Mechanics	Use of evidence, thesis, and claims	Presentation of critical analysis
Pre-test	4.90	6.45	9.75
Post-test	4.85	9.70	9.80

To further determine if the intervention of using the mapping software was successful, a paired t-test was used to determine if there was a significant difference between pre and post-tests. From Table 3, the improvement was significant at $p < .05$, with earlier evidence from descriptive statistics indicating the improvement of means between pre and post-tests; in paired samples correlation (R), the value informs the consistency of scores obtained when the same form of tests or intervention is distributed again (Hinton et al., 2014), and as the R value is only .590, the consistency over time in pre-service teachers may not be evident; the standard error mean shows values that indicate expected means when the value is low (Hinton et al., 2014), and since the standard error mean for post-test was .274, it indicated that if pre-service teachers were to ask to write an argumentative essay again, less variability would occur and not affect the scores. As such, at $t(19) = 6.543$; $p < .05$, there was enough evidence to reject H_0 and significant improvement of using the mapping software in aiding pre-service teachers to write was detected.

Table 3: Results from paired t-test (N=20)

	Mean	R	t	df	Sig	Standard deviation	Std. error mean
Pre-test	21.1	.590	6.543	19	.006	2.713	.607
Post-test	24.4					1.226	.274

Six pre-service teachers from the experiment were recruited to participate in individual online interviews on Microsoft Teams. The pseudonyms assigned were PST1, PST2, PST3, PST4, PST5, and PST6. All interviews adhered to the interview protocol and were recorded, transcribed, and open and axial coded to generate themes to explain the findings from the experiment conducted. Two themes were identified at the end of the analysis.

Theme 1: Perceived benefits of using i-Think maps and mapping software

The first theme identified was that these pre-service teachers found i-Think Maps when drawn on the mapping software had a variety of benefits. PST1 and PST2 stated that these maps helped them to visualise the ideas that they had in mind: "I use mind maps to draw out the ideas, then I can see a clearer picture of the ideas I had in mind" (PST1); "When I use the software, I can have my ideas put on the screen and it will become clearer to me as I can arrange my ideas based on how I want them to" (PST2). PST4 believed that the maps had helped him to expand and lengthen ideas continuously: "I can just keep branching them (ideas) out and fill more ideas into these branches." PST5 also stated a similar benefit of branching ideas, as she responded, "I can keep branching out ideas easily. You can just keep drawing lines and then draw another circle, and then write your ideas in, or maybe just keywords."

From PST2's response, she also mentioned that she "can arrange my ideas based on how I want them to." This meant that the organisation of ideas took place when using the software to draw the maps. PST1 gave a similar response where she could "just slowly organise them (ideas) into the necessary map." She added that such actions on the software would help her "to improve the quality of my assignments too." From the responses, three main benefits were identified, which were visualising ideas, branching of ideas, and organising of ideas. Erdem (2017) has reported that in evaluating students' writing, the presentation of ideas that is done through mind maps helped in generating authentic and meaningful sentences. Further, the branching of ideas is an evidence of constructivism, where these pre-service teachers were shown to be constructing their writing through the ideas presented before writing (Erdem, 2017).

Theme 2: Perceived importance of continuous learning academic writing

The second theme identified was that the pre-service teachers perceived academic writing as an important skill to be acquired in university. PST6 stated that "many assignments need academic writing" and "learning to write academically is difficult in university as it is a different experience in high school." He stated that even though his course of study had offered "academic writing as a subject, it is not enough for [me] to be proficient in (academic) writing for the remaining semesters." Further, PST5 stated that she was not skilled with academic writing so she had to "refer to my previous lecture and tutorial slides to see how I can write sometimes." From her statement, it can be seen that even in her final year of study, she still needed to refer to the educational slides previously obtained, to help to cope with her studies.

Interestingly, PST2 asserted that learning academic writing had become easier as "educational technology is fully utilised to help the students to learn too." She stated that when she was unsure how to write properly in her assignments, she "can learn how to write by watching online videos, tutorials and all those." She too added that academic writing can be learned by "taking the opportunity to use the software as a tool for improvement." In fact, PST1 had stated that "academic writing is very important because the skills are important throughout degree especially in assignments." She further asserted that learning academic writing has become easier amidst the pandemic as "lectures can fully utilise educational technology to teach students how to write better."

PST3 stated that learning how to write academically was important especially "now that a software such as this (mapping software) exists to help us to draw, fill in the boxes, and organise our ideas." In fact, PST5 stated that she "wished that the lecturer introduced a software like this earlier in Academic Writing (subject) back then so I could at least understand the ideas easily in her assignments instead of wasting papers drafting (ideas)."

From the responses, the overall perceptions of the pre-service teachers towards the use of i-Think Maps in the software to write essays were positive. At least three benefits of using the maps and software were identified, which were visualising ideas, branching ideas, and organising ideas; pre-service teachers also asserted that academic writing was important for them to complete university assignments. The pre-service teachers' responses on visualising their ideas through i-Think Maps were similar to Karim et al. (2016) and Swaran et al.'s (2020) statements, where users get to improve their quality of writing, when they can have a clearer picture of the contents after translating their ideas to visible maps. In addition to this, PST1 and PST2's statements about maps helping in organising ideas matched Hamzah and Wan Yusoff's (2021) claim that maps offered better options to manage and organise the ideas that were translated from their thoughts. Further, the aspect of Use of evidence, thesis, and claims, where mean scores showed a difference and improvement in the post-test, though it is not directly evident that HOTS was displayed when the pre-service teachers were writing the argumentative essays, the use of maps had stimulated their HOTS to be demonstrated. This is one of the main aims as stated by MOE (2013; 2015) in the education blueprint and the Malaysian Education Development Plan.

PST5's claims on utilising the software to learn academic writing during the COVID-19 pandemic reflected the literature on the increased use of technology amidst the pandemic (Azman & Abdullah, 2021; Harun, 2020; Shahzad et al., 2020; Swaran et al., 2020; Zolkepli, 2020). Grapragasem et al. (2014) had mentioned that the use of technology was gradually becoming a trend in Malaysia and with the globe thrust into a pandemic, needing online learning in so many countries, technology for learning is now a prominent trend in today's education. Since Tiew and Abdullah (2019) identified the need for educators to seek effective ways to instil HOTS among Malaysian students, and Swaran et al.'s (2020) call for more innovative methods and techniques to teach HOTS and writing, the introduction of this mapping software could be one of the ways to teach pre-service teachers about academic writing. This software could serve future considerations if course designs can integrate it in online teaching and learning. As Azman and Abdullah (2021)

stated, experiences and feedback from students learning amidst the pandemic can help to improve future plans for HEIs to manage education, and bring MOE's (2015) aspirations for students a step closer to realisation.

As their overall perceptions were positive, the respondents help to explain the improvement shown in post-tests. While PST3 stated the mapping software helped in learning academic writing, other methods to learn academic writing were mentioned by other pre-service teachers. Learning aids such as lecture and tutorial slides (stated by PST5) and online videos and tutorials (stated by PST2) open up matters for suggestions and research about other forms of resources and interventions, that can help pre-service teachers learn academic writing.

Conclusion

Academic writing plays a significant role in many university assignments, theses and dissertations (Al-Zubaidi, 2012; Singh, 2015). Even at the tertiary level in HEIs, writing continues to be a skill that is difficult to attain, even though university learning requires academic writing throughout an entire degree program. (Akhtar et al., 2019; Al-Zubaidi, 2012; Musa et al., 2012; Singh, 2015; Sovakandan et al., 2017; Swaran et al., 2020; Yunus et al., 2013).

Apart from MOE's (2013; 2015) aspirations for students, it has long been its intention, articulated clearly in the education blueprint, to produce more graduates ready for employment in various fields and possessing HOTS needed for Malaysia's development. Research is one of the important elements that constitute learning in universities, and it is also in MOE's (2015) aims to have Malaysian HEIs to continue moving higher in various university rankings. During the pandemic, Azman and Abdullah (2021) and Swaran et al.'s (2020) claims to be more innovative in learning must be echoed not only among HEIs but also in all kinds of educational institutions at large, to realise MOE's aspirations. Pre-service teachers who are potential teachers in the future need to be skilful in research as they will need to perform action research to improve the state of education, as Norasmah and Chia (2016) have asserted. Publishing their results helps educators to improve their pedagogical knowledge and practices, but this requires teachers to attain effective scholarly and academic writing (Norasmah & Chia, 2021).

However, this research was conducted in a private HEI located in the state of Perak, Malaysia and only a small sample of pre-service teachers participated. From a practical aspect, future research should consider expanding the use of i-Think Maps and the mapping software to other HEIs and different options majored by pre-service teachers. Larger samples from both public and private HEIs are needed to show generalisation and enhance the significance of the research. The researchers have to acknowledge that the samples recruited for the study may be arguably biased. Firstly, the private HEI consists of many Chinese and Indian students, with the Chinese ethnicity being the majority in the institution. While there are some students who are ethnic Malays, when conducting the research the researchers realised that there were no ethnic Malays in the sample. Also, it is

unknown whether the pre-service teachers' first language was English language or their ethnic language, Chinese or Tamil. A first language that is not the English language would affect language performance (Koh et al., 2019).

Malaysia being a multi-ethnic and multicultural country, future research should address these limitations so as to attain more generalisable results that better represent the nation. Further, it was unknown how experienced and competent these pre-service teachers were in academic writing as their previous experience of learning academic writing in subjects Academic Writing and Research Methodology was not explored; the extent of receiving feedback during the learning process was not explored as well. Future research may provide a diagnostic test to determine the extent of competency prior to conducting the research. Additionally, as the researchers were not full experts, neither professionally experienced in academic writing, future research should involve experts and incorporate feedback as part of evaluating the essays received, as well as more rigorous research methods to strengthen and validate the results.

In terms of clinical aspects, relevant parties from HEIs could consider teaching academic writing through more innovative methods such as incorporating this software into a number of courses. Although in this research the researchers were able to access the *Edraw* software conveniently, HEIs across Malaysia, inclusive of those offering teacher education programs, could obtain a license for using *Edraw*, to conveniently aiding all higher education students engaged academic writing. The website has provided detailed plans for purchasing and HEIs can make purchases accordingly.

Further, it is already well-established in the literature that academic writing is stressful to many students pursuing tertiary education (Akhtar et al., 2019; Al-Zubaidi, 2012; Musa et al., 2012; Singh, 2015; Sovakandan et al., 2017). Generating ideas through many rhetorical contexts in different disciplines in tertiary education have not made academic writing any easier (Akhtar et al., 2019; Al-Zubaidi, 2012). By understanding pre-service teachers' experience in learning academic writing, HEIs could plan their courses to enable academic writing skills be learnt throughout degree study, instead of treating it as a single subject learnt in a single semester. As aforementioned, as prospective teachers conducting educational research is crucial for improving the quality of education in the nation (Creswell, 2014; Creswell & Guetterman, 2019; Norasmah & Chia, 2016). While pre-service teachers may use different strategies in learning and engaging in academic writing, the incorporation of *Edraw* as a form of educational technology would help in facilitating learning. Teachers are expected to employ educational technology in classrooms as articulated in the Malaysian Education Blueprint (MOE, 2013) and hence, showing mastery on using *Edraw* to deliver writing lessons helps them to become proficient teachers.

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Appendices

Interview protocol

Before interview
• Check if the interview questions are ready.
• Check if necessary stationary is ready for notetaking during the interview.
• Check if the Internet connection is stable for the interview (https://fast.com).
• Check if the surrounding environment has minimum, if possible, no noice interruption.
• Check if the intended pre-service teachers have entered Microsoft Teams.
• Check if all setting is ready.   > Audio [Note: Both sides must be able to hear clearly].   > Camera [Note: Participant(s) may choose to off the camera].   > Recording.
• Check if the pre-service teachers do consent and agree to the interview.
• Check if all sides are ready for the interview.

During interview
• Follow the interview questions established.
• Pre-Interview   > Greet the participant.
• During Interview   > Follow the interview questions established.
• End of Interview   > Thank the participant.
• Stop recording only after the participant has left the platform.
• Contingency procedure   > Should the interview be interrupted (e.g., poor Internet connectivity), allow   switching of platforms or reschedule for another interview.

After interview
• Check if the platform has successfully recorded the interview.
• Check if the interview recorded is of audible quality.
• Download the interview recorded for later analysis.
• Label all notes taken, should any notetaking occurs, according to the interview conducted for easier retrieval.

Interview questions

Pre-interview
• Good day [morning / afternoon / evening], how are you doing?
• Express gratitude for participating in the interview.
• Inform the purpose of the interview.   > Probe: Recap the objectives and process of the research.   > Reveal only the participant's pre and post-test results.
• Shall we begin the interview?

During interview

- How do you feel about your writing performance based on the results?
  > Recap the participant's pre and post-test results.
- How do you feel when writing the essay?
  > Follow up question: Can you please describe more on the particular experience?
- How do you feel when the *Edraw* software is introduced?
  > Probe: Recap the past four week's of intervention.
  > Follow up question: How do you feel about drawing mind maps on *Edraw*?
  > Follow up question: How do you feel about the functions available in *Edraw*?
- Do you experience any difficulties when using *Edraw*?
  > Follow up question: Why do you say so?
- Do you think this software is suitable for lectures on Academic Writing?
  > Follow up question: Why do you say so?

End of interview

- Inform the interview has come to an end.
- Express gratitude for participating in the interview.
- Allow the participant to leave the platform.
- Stop the recording.

Accessing high resolution Figures 2 and 3

Figure 2: Download http://www.iier.org.au/iier32/tay-fig2.jpg (about 180 kB)
Figure 3: Download http://www.iier.org.au/iier32/tay-fig3.jpg (about 182 kB)

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