Improving Narrative Writing Performance through Digital Mind Mapping: A Mixed-Methods Investigation of Cognitive Engagement and Skill Development

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Abstract **– This study investigates how the impact of mind-mapping techniques on improving students' narrative writing skills, addressing challenges in organizing thoughts, and creating coherent written work. The aim of the study is to determine if mind mapping can significantly enhance writing performance. Using a sequential explanatory design and mixed-method approach, the research examined the effects of mind mapping on students' writing abilities. The results showed a marked improvement in writing, particularly in structure and clarity. Statistical analysis revealed a significant difference between the two experimental groups, with the first group performing better, supported by a posttest result (p-value = 0.001, less than 0.05). Both groups expressed high satisfaction with mind mapping, finding it engaging and helpful. These findings suggest that mind mapping improves writing performance and enhances students' learning experience.**

Keywords **– Mind mapping digital, writing skills, primary school, capital city, regency.**

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1. Introduction

The increasing pace of global development presents teachers with significant challenges, compelling them to rethink traditional pedagogical approaches and integrate more dynamic, student-centered methods into their classrooms. The function of education today holds immense significance, as it plays a central role in preparing students to face the complex, multifaceted challenges of the twenty-first century. For students to succeed in this ever-changing environment, education must offer diverse opportunities to develop academic knowledge and essential life skills. The capacity to adapt to various situations and effectively use the knowledge and skills learned during their education is crucial for success in today's world [1], [2], [3]. In particular, students must master critical thinking, creativity, communication, and collaboration — the “four Cs” — competencies that are central to thriving in the modern era [4], [5], [6]. These skills are foundational for academic achievement and indispensable for personal growth and professional success. Therefore, educational systems must move beyond traditional methods and embrace innovative approaches that holistically support the development of these skills.

This study was conducted across two distinct elementary schools: one in the Indonesia’s Capital Region of Jakarta, an urban area, and the other in Malalak District, Agam Regency, a rural region in West Sumatra Province. Interviews with teachers and students revealed some significant issues regarding narrative writing. Regardless of location, many students showed signs of hesitation and distress when attempting to write narratives. This resulted in poorly organized writing, as students struggled to translate their ideas into coherent, well-structured texts effectively.

Although ideas for the essays were present, articulating these thoughts in writing with clarity, flow, and appropriate language proved difficultIt became evident that their lack of writing practice was a primary contributing factor to these challenges. Teachers further emphasized that students' difficulties in narrative writing stemmed from a range of obstacles, including fear of making mistakes, the perception of writing as an arduous task, limited vocabulary mastery, and a tendency to rely on their mother tongue or everyday language, which hindered the ability to express ideas effectively in written form. This issue was not confined to a specific geographic area but was prevalent in urban and rural schools, highlighting broader challenges in writing education across Indonesia. The stark contrast between urban and rural areas regarding educational resources and opportunities exacerbates these challenges, as urban regions benefit more from concentrated development and access to educational technologies. In contrast, rural areas suffer from a lack of resources, increasing poverty, and educational inequality. Consequently, there is an urgent need for the government to address these disparities and implement policies that promote equal development, particularly in the educational sector, to ensure that all students, regardless of their location, have access to the tools and opportunities needed to succeed.

Regardless of background, religion, nationality, or geography, every citizen is entitled to the same quality of education. In actuality, though, the government gives urban education more priority than rural education. Urban students are better at verbal and numerical reasoning than rural children, while rural schools are often lower quality [7], [8]. There are potential problems with expanding rural schools, particularly with opening new institutions. Nonetheless, rural schools prioritize teaching established criteria and have comparatively little teacher absenteeism. Facilities, infrastructure, and the caliber of teachers are the main causes of the educational disparity between urban and rural areas [9], [10]. From the general public's standpoint, urban education is superior to rural education. This syndrome is consistent with the findings of Richard Mark Wood's research. The study's conclusions demonstrated that urban schools have greater resources than rural ones regarding teacher preparation, the quality of instruction, and the completeness of the infrastructure and amenities [11], [12], [13]. Significant gaps in a variety of subjects were induced by location, according to other empirical research that was restricted to accessible places and did not utilize nationally representative samples because of logistical and resource constraints [10], [11].

On the other hand, other research has claimed that pupils in rural schools are better off than urban pupils. Indeed, Chinese research found no discernible difference between the quality of schools in urban and rural areas [13], [14], [15], [16].

In addition to student learning achievement, school conditions also reveal the disparity between rural and urban schooling. Respondents' answers about class size, academic resource availability in schools, school infrastructure and amenities, and school characteristics form the basis of the study on school conditions. Without considering urban or rural locations, schools must have the bare minimum of infrastructure and facilities required by the Government of the Republic of Indonesia to facilitate the educational process. In actuality, though, not all rural schools are treated equally to those in urban regions. For instance, projectors and reliable internet network data have not been adequately provided to schools in rural areas. Equalizing the facilities and treatment is a significant concern for Indonesian education. Undoubtedly, there are differences in the infrastructure and educational facilities across schools and areas. All equipment, supplies, materials, and equipment utilized directly or indirectly for educational activities are considered school facilities since the school owns them. Educational infrastructure consists of yards, gardens, parks, roads, rules, and so forth that obliquely support the teaching or learning process. Rural schools continue to have lower expectations for these amenities than metropolitan schools.

In acquiring proficiency in Indonesian, particularly in the composition of narratives, students frequently encountered difficulties identifying the main ideas to be conveyed in their written work. The students demonstrated continued difficulty in solving problems related to writing narratives and in describing their writing in narrative form. Additionally, the students demonstrated a lack of confidence in their ability to construct sentences that effectively convey the narrative elements of their writing. One strategy for fostering the growth of ideas among students in the learning process is using essay writing. The term "essay" is essentially synonymous with "writing." However, there are notable distinctions between the two. "Essay" is employed when composing fiction or non-scientific texts, whereas "writing" is utilized in the context of scientific or non-fiction writing. One of the most definitive ways to demonstrate the acquisition of language skills and abilities is through writing, which follows the acquisition of speaking, reading, and listening skills [17], [18], [19]. It has been asserted in other sources that the acquisition of writing skills presents a greater challenge for language learners than the acquisition of other fundamental language skills.

This is because the production of coherent written texts necessitates the mastery of a range of non-linguistic skills. Writing effectively requires communicating through written language [20], [21], [22]. Consequently, the ability to write necessitates the integration of diverse competencies, including the aptitude for conveying ideas, the capability for organizing these ideas, the proficiency for applying grammatical and syntactic patterns, and the ability to select structure and vocabulary. Given that writing skills engage the cognitive system, they are the most challenging to master. To produce ideas, students must think critically and compose sentences and paragraphs. Writing is an indirect ability that does not necessitate direct or in-person engagement with others [22], [23], [24]. Writing down thoughts, concepts, and emotions is made possible by thinking.

In light of the aforementioned explanation, the present study proposes a methodology that may enhance students' writing skills through digital mind mapping. In the contemporary era, digital learning is necessary due to the exponential growth of digitalization and the need for students to be equipped to navigate the challenges of the 21st century [25], [26], [27]. Digital mind mapping is defined as the process of representing ideas, information, or concepts in a continuous digital mind map. This methodology was proposed to give students a fundamental framework before writing. To assist them in producing more structured and detailed writing. Mind mapping aims to facilitate systematic concept organization and enhance cognitive abilities [28], [29], [30]. Students who utilize mind mapping are anticipated to demonstrate enhanced reasoning, information integration, and conceptualization abilities. Additionally, mind mapping enhances learning and fosters creativity, facilitating student learning [31], [32], [33]. Stokhof posits that mind-mapping techniques can improve brain function, facilitate information retention, and foster critical thinking, all of which contribute to lifelong learning and the growth of students' ideas [34], [35]. This study aims to ascertain the impact of digital mind mapping, a 21^{st}-century learning approach, on the writing skills of primary school students. To this end, a comparative analysis examined students' writing proficiency scores in schools in a rural regency and a capital city region.

The Canva program was used to create the mind map that was utilized. Researchers selected the Canva app because it is feature-rich, affordable, and simple. Users of Canva may make digital art, movies, presentations, and even websites in addition to designing visual content. Canva offers a wide range of eye-catching designs, which can boost teachers' and students' creativity in creating educational materials due to its many features, and can save time when creating practical learning materials without requiring a laptop, thanks to its gadgets and flexibility.

Instructors find Canva to be a very useful tool for using technology, according to interviews with both instructors and students. Teachers find it easier and more creative to create instructional materials. Students in elementary school are also accustomed to knowing how to use Canva. Because Canva offers so many intriguing templates, students said they had no trouble developing mind-mapping ideas. Many pupils have been able to create their homework ideas. Students' creativity in learning can be developed using Canva to create mind maps. The advancement of science and digitization in the contemporary era is inevitable and inescapable. Given the rapid pace of scientific and technological advancement, it is incumbent upon individuals to leverage this advancement to their advantage [35], [36], [37]. Subsequently, the methodologies utilized for learning must undergo a modification, as the educational sector must also demonstrate the capacity to align itself with the pace of technological advancement. In the twenty-first century, students' skills and talents are evolving in conjunction with the methods of instruction. This is related to the foundation of digital literacy, skill, and character traits among students [38], [39], [40]. Given the accessibility of digital media and its capacity to provide instructional resources at all times and from any location, it is crucial to utilize it in education in an interactive manner to create a more engaging and dynamic learning environment [41], [42], [43]. In this regard, digital learning is invaluable in enhancing learning engagement, facilitating face-to-face communication, and empowering self-directed learning. Additionally, it facilitates knowledge sharing [35], [36], [44].

To prepare students for success in the twenty-first century, they must be provided with a curriculum that allows them to master the skills that will be required of them in the modern world. Examples of 21^{st}-century skills include critical thinking, communication, teamwork, creativity, life and career skills. The educational process aims to enrich students' lives and equip them with the skills and knowledge required to become contributing members of society [45], [46]. To prepare education for the twenty-first century, UNESCO has established four pillars of lifelong learning: learning to know, learning to do, learning to be, and learning to live together. These four pillars collectively facilitate the actualizing oneself as a unique, autonomous person with a personality [47], [48]. The 21^{st} century learning framework, which calls for students to possess knowledge, skills, and abilities in the areas of technology, media, and information; learning skills; innovation; life skills; and competitiveness, fosters the development of 21^{st} century learning partnership capabilities [49], [50], [51]. One of the most challenging skill competencies for students to master is writing.

This is because students, especially the younger ones, often struggle to select appropriate vocabulary, write coherent texts, and construct paragraphs that flow well. Furthermore, three structural components are involved in constructing a written narrative text. As the content of each component is identical, it can be challenging for students to determine which part belongs in the narrative, identification, and classification/definition sections. A paucity of vocabulary, an absence of knowledge regarding grammatical standards, and a dearth of writing confidence are among the factors that contribute to students' inability to write effectively [44], [45]. The most prevalent issues in students' writing include a paucity of ideas, an inappropriate selection of vocabulary, grammatical inaccuracies, and a dearth of transitional words. Concerning writing, elementary school students typically struggle to select appropriate vocabulary, organize ideas in a coherent sequence, and adhere to grammatical conventions [52], [53], [54], [55]. The novelty of this study is the significant use of digital learning in elementary schools. This digital learning is combined with the creation of mind mapping by students with software assistance. Mind mapping aims to train and improve students' writing skills, especially writing in the current digital era.

2. Methodology

This study employed a hybrid methodology, integrating quantitative and qualitative techniques within a sequential explanatory design framework. A mixed-methods approach, commonly referred to as a "sequential explanatory design," involves the application of quantitative methods in the first phase, followed by qualitative methods in the second phase to provide a comprehensive analysis of the research problem [56], [57], [58].

This sequential approach enables the researcher first to collect and analyze numerical data, providing a broad overview of the research problem before delving into more detailed, contextual insights through qualitative data collection. The initial phase of this study involved the experimental procedure, which comprised a pre-test, treatment, and post-test. The pre-test allowed for the assessment of students' writing skills before implementing the intervention, which, in this case, used digital mind mapping as a tool to enhance narrative writing. Following the pre-test, the treatment phase involved the application of the digital mind-mapping technique to support students' writing activities. Finally, the post-test was administered to evaluate any improvements in the students' writing skills after the treatment. This structured experimental design helped to determine the efficacy of digital mind mapping in improving students' writing abilities.

The second phase of the study employed a qualitative approach to gain a deeper understanding of the impact of digital mind mapping on students' writing skills. Semi-structured interviews were conducted with the students and their teachers to gather insights into their experiences with the intervention. This qualitative data collection allowed a richer understanding of the students' perceptions, challenges, and motivations for digital mind mapping in their writing tasks. Figure 1 below illustrates the overall process of the study, showcasing the step-by-step progression from the pre-test phase through the treatment with digital mind mapping and concluding with the post-test and qualitative interviews.

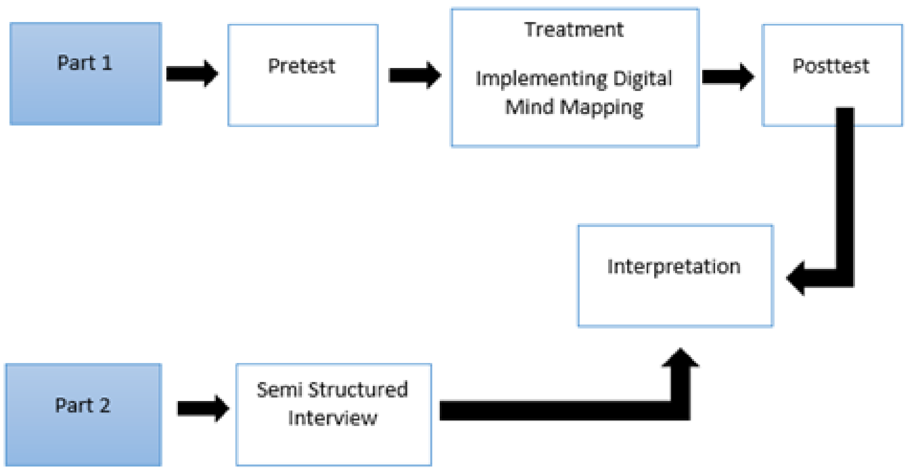

Figure 1. Research procedure

This study was carried out in two distinct experimental classes. The first group consisted of fifth-grade students from East Cilandak 01 Public Elementary School located in the Jakarta capital region. In comparison, the second group was made up of fifth-grade students from Sasai Kandang 10 Public Elementary School in the Malalak District of Agam Regency, West Sumatra Province. The purpose of this design was to examine whether there were differences in the writing skills of students from these two schools after using digital mind mapping. The study involved 50 elementary school students, 35 from East Cilandak 01 Public Elementary School and 25 from Sasai Kandang 10 Public Elementary School. The sample was chosen using purposive sampling based on the range of participants. The instruments employed included pre-test, post-test, and semi-structured interviews. The study was conducted over eight weeks, with 60-minute sessions held each week. The students were introduced to digital mind mapping during the first two weeks. In the third week, a pre-test was administered, and from the fourth to sixth weeks, the students engaged in learning activities incorporating digital mind mapping to enhance their writing skills by organizing their thoughts and ideas visually. A post-test was conducted in the seventh week, and a semi-structured interview was held in the eighth week. Quantitative pre-and post-test data were collected, compared, and analyzed using SPSS software and descriptive statistics. The quantitative analysis involved three tests: 1) the homogeneity test, 2) the normality test, and 3) hypothesis testing using the F-test or one-way ANOVA. The qualitative data from the semi-structured interviews were analyzed thematically, with codes and themes to organize the findings.

3. Results

Writing skills refer to the ability to express ideas through written language in a coherent, well-structured manner and easily comprehensible to the reader. These skills go beyond the mere ability to represent graphic symbols in a way that resembles written language or to arrange words into sentences according to established rules [59], [60]. Writing, as an act, utilizes written language as a medium for communicating ideas or thoughts. It is not merely a mechanical process but a complex activity requiring organized thinking and mastery over various writing techniques. These include vocabulary mastery, ensuring unity of ideas, using clear and concise sentences, and constructing well-organized paragraphs [60], [61], [62]. To compose high-quality essays, students must engage in various writing activities that build their grammatical skills, content generation abilities, stylistic finesse, mechanical precision, and decision-making in the writing process [63], [64], [65].

Given this complexity, writing skills can be understood as a series of processes that require several stages of development, transforming ideas into written form that the reader can understand. The writer's goal is to evoke thoughts and feelings through the written word, which are then conveyed to the reader. For students, writing development follows principles that guide their learning process. The first is the recurring principle, which suggests that students will come to understand the recurring forms of words. The second is the generative principle, where students develop a more detailed understanding of the structure and forms of writing. The third is the sign concept, where students learn to understand symbols in written language. The fourth is the flexibility principle, emphasizing that students should understand transforming those signs into other forms. Finally, the directionality principle stresses that students should grasp the linear nature of writing, moving from left to right and from one word to another [19], [25], [64].

The mind mapping method emerges as a valuable pedagogical approach in this context. Developed by Tony Buzan in the early 1970s, mind mapping is a creative and practical method for organizing thoughts, facilitating note-taking, and enhancing memory retention [66], [67]. Buzan's mind mapping technique has been widely recognized for its potential to optimize learning outcomes. Hua Yang further supports this notion, describing mind mapping as an imaginative tool that significantly aids in retaining information [28]. Mind maps act as a roadmap for learning by organizing and connecting related concepts visually, making them easier to comprehend and recall. This technique has been shown to improve memory retention and the organization of thoughts, making it a powerful tool for students to enhance their writing skills. By incorporating mind mapping into the writing process, students can gain a clearer structure for their ideas, leading to better-developed essays and more coherent writing [32], [34].

The present study employed digital mind mapping with the assistance of the online graphic design platform Canva. The students were permitted to create digital mind maps using the platform, with the freedom to be creative and explore their writing skills following the established rules and materials set forth by the present study. The creation of mind maps digitally offers several advantages, which is why they are frequently employed in educational settings. The advantages of digital mind mapping include: 1) fostering student interest in learning to use mind mapping, as it allows for the use of a wide range of colors and ornaments; 2) enhancing the memorability of concepts or ideas by aligning with the brain's, 3) using a single keyword, thus stimulating students to generate new ideas easily and helping them recall their memories; and 4) displaying information in full and in detail simultaneously [29], [31].

In addition to these advantages, digital mind maps are simpler, portable, and not limited by document size. A quantitative analysis was conducted in the present study's initial phase. The initial step involved examining the mean pretest and posttest scores of students in experimental classes 1 and 2 on writing skills. The results are presented in Table 1 below.

Table 1. A comparison of the pre-test and post-test results for experimental classes 1 and 2

Writing skills		N	Minimum	Maximum	Mean
Experimental Class 1	Pre-test	25	53	74	70.03
	Post-test	25	74	92	85.60
Experimental Class 2	Pre-test	25	46	71	69.72
	Post-test	25	65	88	78.00

The data presented in the Table 1 reveals a noticeable difference between students' mean pre-test and post-test scores, highlighting the impact of the digital mind mapping intervention on their writing skills. Initially, the mean pre-test score for experimental class 1 was 70.03, while the mean pre-test score for experimental class 2 was 69.72. The small difference of 0.31 between the two groups indicates that, prior to the intervention, students from both classes demonstrated similar levels of proficiency in their writing skills. After undergoing the digital mind mapping learning process, however, the post-test results show a clear divergence in performance. The mean post-test score for experimental class 1 was 85.60, significantly higher than the mean post-test score of 78.00 for experimental class 2. The difference of 7.6 points suggests that the use of digital mind mapping had a more substantial effect on students' writing skills in experimental class 1. This indicates that the students in this class improved their writing more after the intervention.

To assess the statistical significance of these differences, a series of tests were performed. The first test conducted was a normality test on the pre-test and post-test data for both experimental class 1 and experimental class 2. The results of this normality test, which are provided in Table 2, offer further insights into the data distribution and the reliability of the observed differences.

Table 2. Results of the normality test of of the data on writing skills

Normality Test				
Class		Shapiro-Wilk		
		Statistics	df	Sig.
Experimental Class 1	Pre-test	.739	25	.132
	Post-test	.745	25	.095
Experimental Class 2	Pre-test	.746	25 ,	.167
	Post-test	.702	25	.106

The normality test made decisions by comparing the significance value (sig.) obtained from the Shapiro-Wilk test with the 0.05 threshold. If the significance value was greater than 0.05, it suggested that the data followed a normal distribution, indicating that students' writing skills in both experimental class 1 and experimental class 2 were normally distributed. This is important because the assumption of normality is essential for the validity of subsequent statistical tests, such as the analysis of differences between groups. The Shapiro-Wilk test is commonly used in small sample sizes to assess whether the data deviates significantly from a normal distribution. By ensuring that the data follows a normal distribution, it is possible to confidently proceed with further statistical analysis, such as the homogeneity test, which examines whether the variances between the two groups are equal. The results of the homogeneity test, which are detailed in Table 3, offer additional insights into the consistency of the data between the two experimental groups. This test helps to determine if the data across both groups are comparable, further justifying the validity of any differences observed between the pre-test and post-test scores. The homogeneity test serves as a critical check for ensuring that any observed effects are not due to underlying differences in the variability of the groups.

Table 3. Homogeneity of data on writing skills

Test for Homogeneity of Variances			
Levene Statistics	df1	df2	Sig.
.461	3	96	.653

The homogeneity test results, as shown in Table 3, were derived from the data on students' writing skills obtained through both pre-test and post-test assessments. The methodology used for the homogeneity test followed a similar approach to the normality test, where the significance (sig.) values were compared to the 0.05 threshold. Specifically, the homogeneity test examined whether the variances in the writing skills data across the two experimental groups were equal, which is an important assumption for certain statistical analyses. As presented in Table 3, the significance value (sig.) of 0.653 is greater than the 0.05 threshold. This indicates that the variance in the data for students' writing skills was homogeneous, meaning the spread or variability of the scores was similar across both experimental class 1 and experimental class 2. The homogeneity of variance ensures that the two groups are comparable and that any differences observed in their writing skills are not due to unequal variability between the groups.

After confirming that the data were both normally distributed and homogeneous, the next step in the analysis was to test the hypothesis using the F-test, or one-way ANOVA.

This test evaluates whether there are statistically significant differences in the means of the groups.

The results of the hypothesis testing using the F-test are provided in Table 4, offering further insights into the impact of the digital mind mapping intervention on students' writing skills.

Table 4. The results of ANOVA

ANOVA					
Writing skills					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	430.673	1	439.671	8.359	.001
Within Groups	3468.875	49	49.182		
Total	3784.929	50			

To conclude the one-way ANOVA, it is essential to evaluate whether the significance level (Sig.) is below the threshold of 0.05 ($\alpha = 0.05$, or 5%). As shown in the previous table, the significance value (Sig.) was found to be 0.001, which is significantly lower than 0.05. This result indicates that there is a statistically significant difference between the post-test scores of experimental class 1 and experimental class 2 in terms of their writing skills after the implementation of digital mind mapping. In other words, the application of digital mind mapping had a measurable effect on the students' writing abilities, with a notable improvement in one of the experimental groups. Following the statistical analysis, the next phase of the study involved conducting semi-structured interviews. The purpose of these interviews was to further explore the extent of the observed differences and gain deeper insights into how digital mind mapping influenced the writing skills of the elementary school students. The semi-structured interviews were carried out with participants from both experimental class 1 and experimental class 2, allowing for a more nuanced understanding of the students' experiences with the digital mind mapping tool. These interviews provided valuable qualitative data that complemented the quantitative findings, offering a more comprehensive perspective on the effectiveness of the intervention.

4. Discussion

A semi-structured interview was conducted using a set of open-ended questions, allowing participants to freely respond in their own words while remaining focused on the predefined themes of the study. In semi-structured interviews, the flexibility of open-ended questions enables the research subjects to express their thoughts in a detailed and personal manner, while still ensuring that the responses align with the overall research objectives [68], [69].

This method strikes a balance between providing structure and allowing for in-depth, insightful responses. The interview responses from participants were then analyzed and categorized into codes and themes, as presented in Table 5. This thematic analysis allowed for the identification of key patterns and insights from the interviews, offering a deeper understanding of the impact of digital mind mapping on the students' writing skills. By organizing the data into codes and themes, the study systematically interpreted the qualitative feedback and linked it to the quantitative findings, thus providing a comprehensive overview of the intervention's effects.

Table 5. Semi-structured interview

Code	Theme	Example Questions
Memory	Memory retention	Please recall the learning concepts that will be developed in digital mind mapping.
	Reinforcement of learned concepts	Can you synthesize the key takeaways from a lesson using digital mind mapping?
Planning	Relevance of ideas	Are you able to distinguish between reliable and unreliable sources of information online and in your personal network?
	Consistency of ideas	Do you feel satisfied with the results of your work?
	Timing	Are you able to complete digital mind mapping in a timely manner?
Skills	The art of mind mapping	Are you able to create a well-structured mind map?

As the table above demonstrates, the semi-structured interview was structured around three primary codes and six associated themes. These codes and themes were carefully selected to guide the analysis of the interview data, ensuring that the responses were categorized in a way that aligned with the research objectives. Each code represents a central concept or area of focus within the interviews, while the themes provide a more detailed breakdown of the specific aspects of these concepts. This systematic approach to coding and thematic categorization allowed for a comprehensive analysis of the participants' responses, facilitating the identification of key patterns and insights regarding the impact of digital mind mapping on students' writing skills. By organizing the data in this way, the research ensured a structured yet flexible framework for interpreting the qualitative data, linking the interview findings to the broader research questions.

4.1. Memory Code

The first question of the study sought to explore students' recollections of their experiences while creating a digital mind map using the Canva platform. The findings from students at Cilandak Timur 01 Public Elementary School indicated that most could recall the concepts and materials intended to include in the digital mind maps. When faced with challenges, these students actively sought assistance from the teacher, who in this case was the researcher. This demonstrated a proactive learning attitude and willingness to engage with the tool, even when difficulties arose. A similar pattern was observed at Sasai Kandang 10 public elementary school, where half of the students were able to recall the relevant concepts clearly. However, it was noted that not all students had the same level of clarity, indicating possible variations in individual learning experiences and comprehension.

The second question examined the students' ability to summarize material using digital mind mapping. Cilandak Timur 01 Public Elementary School and Sasai Kandang 10 Public Elementary School students strongly preferred the mind mapping method. It was identified as an effective tool for making learning more enjoyable and less stressful, which led to greater engagement with the lesson content. This preference was attributed to the visual and interactive nature of digital mind mapping, which allowed students to capture the key points from the lessons in a more organized and structured manner. Students reported that the method helped them reinforce their understanding of the material, aiding in better retention and comprehension. The feedback collected underscored the potential of digital mind mapping as a valuable pedagogical tool to enhance the learning experience and improve students' ability to summarize and internalize complex content. Both sets of data from the two schools suggest that digital mind mapping, especially when facilitated through user-friendly platforms like Canva, significantly impacts students' ability to recall and summarize material. This approach's interactive and visual nature makes it an effective learning tool that can improve engagement, comprehension, and retention, thereby enhancing the overall educational experience.

4.2. Planning Code

The third question pertained to selecting information from various sources, including books, the internet, and classmates. The results of this question indicated differences in the responses between the two classes. Cilandak Timur 01 Public Elementary School students could easily obtain information due to the adequate facilities.

In contrast, students at Sasai Kandang 10 public elementary school required a somewhat longer time to obtain information due to the presence of an unstable internet network. Additionally, many students lacked the knowledge to search for information on the internet effectively. Moreover, the unstable internet network resulted in students at Sasai Kandang 10 Public Elementary School 10 requiring more time to complete the digital mind mapping project. This subsequently influenced their responses to the fifth question. The students from both schools acknowledged that they lacked proficiency in filtering information from the internet, prompting them to seek guidance from their teachers and solicit opinions from their peers regarding the veracity of the information. The fourth question revealed that all students expressed satisfaction with the results of their mind-mapping endeavors. In the final question regarding the time required to complete the mind mapping task, students indicated that some were able to complete it within the allocated time frame, while others required additional time. The latter group attributed their inability to finish within the designated period to selecting colors, themes, sizes, and fonts for their mind maps.

The results showed that implementing digital mind mapping among elementary school students significantly improved their writing skills. The students demonstrated an ability to retain new vocabulary and engage in meaningful repetition with the assistance of mind mapping. The graphs and pictures in the mind maps assisted with motivation and memory retention for the students. This is because mind maps serve a mnemonic function in vocabulary learning, allowing students to retain vocabulary in their long-term memory for extended periods [32], [67]. As a result of the ease with which mind maps can be reviewed, students' memories will become more robust with repeated exposure. It is, therefore evident that the application of mind mapping strategies facilitates the retention of concepts and terminology, while simultaneously reinforcing prior learning. Furthermore, the mind mapping method, which is perceived to be somewhat distinctive, provides a succinct overview or establishes connections between concepts, facilitating rapid idea generation. Students may prepare their ideas and points before commencing writing to facilitate the writing process. In this study, students reported that the mind mapping method enables them to identify important points easily and divide the content into smaller units. The branches in mind maps are readily visible, allowing students to write with clarity and precision and preventing the conflation of ideas. This illustrates how mind mapping supports the organization of concepts for the composition of a narrative essay.

4.3. Skill Code

The mind map can be utilized as a central nexus to connect key ideas, thereby rendering mind mapping a relatively simple yet effective brainstorming technique. Mind mapping improves essay quality and facilitates comprehension by emphasizing concepts expressed in the students' own words and knowledge when employed as a preliminary writing tool. Students may be able to write more effective essays when utilizing mind-mapping techniques to help them generate their own connections and associations. This will assist them in enhancing their ideas and creating a coherent, well-written narrative [34], [70]. Utilizing mind maps facilitates a more purposeful approach to learning by visualizing concepts. Its principal purpose is to demonstrate students' capacity for logical reasoning and the advancement of their cognitive abilities and competencies. Furthermore, mind maps can be utilized to document students' thought processes to ascertain their understanding of newly presented information. Additionally, it is asserted that mind maps enhance students' cognitive abilities and provide a methodical analysis [70], [71]. Students may also find it an efficacious tool for recalling the connections that link one idea to another, as it allows for the visual sorting and arrangement of ideas in an organized manner. This may, in turn, enhance students' ability to remember things better.

Digital mind mapping was found to enhance the student's writing skills in the present study. The method proved to be an efficacious pre-writing tool, facilitating not only enhanced writing skills in students but also a greater inclination to write. The students were motivated and found it easier to formulate ideas in writing when using mind mapping. The majority of students found mind maps satisfactory because mind maps helped them study and allowed them to track their progress [71]. It is anticipated that students will feel more driven to learn and satisfied with their learning outcomes when they are not anxious about the results and are content with the learning environment. Moreover, the data indicated that students were satisfied with digital mind-mapping tools. This was demonstrated by their positive responses while composing narrative essays using digital mind maps. The favorable feedback from students indicates that using digital mind mapping is enjoyable. The novelty of this study is the significant use of digital learning in elementary schools. This digital learning is combined with the creation of mind mapping by students with software assistance. Mind mapping aims to train and improve students' writing skills, especially writing in the current digital era.

The findings from the study provided clear insights into the impact of digital mind mapping on students' writing skills.

The first theme, *Memory Code*, focused on how students recalled and summarized material using the digital mind mapping tool. Data revealed that students from Cilandak Timur 01 Public Elementary School and Sasai Kandang 10 Public Elementary School generally recalled the concepts intended to include in their mind maps, with varying degrees of success. Students who struggled, particularly in Sasai Kandang 10, actively sought help from the teacher, indicating an engaged and proactive learning attitude. Both sets of students preferred digital mind mapping due to its interactive and visual nature, making learning more enjoyable and less stressful. This aligns with previous research suggesting that visual aids in learning enhance memory retention and comprehension. The mind mapping tool helped students organize ideas in a structured way, reinforcing their understanding and allowing them to capture key points more efficiently. Therefore, digital mind mapping emerged as a valuable tool for improving memory recall and summarizing complex content, which ultimately strengthened students' writing abilities.

In the second theme, *Planning Code*, the study investigated how students gathered and selected information from various sources. Results revealed disparities between the two schools in terms of access to information. While students at Cilandak Timur 01 had better access to resources and internet facilities, those at Sasai Kandang 10 faced challenges due to unstable internet connections and limited information search skills. This disparity in access to resources affected students' time creating their mind maps. Moreover, the difficulty in filtering information prompted students to seek guidance from teachers and peers, underscoring the importance of support in the information-gathering process. Despite these challenges, students expressed satisfaction with the results of their mind-mapping efforts. Digital mind mapping proved to be an efficient tool for organizing and retaining information, as students found it easier to select and categorize information when aided by a structured, visual format. This process improved their writing skills and helped them retain vocabulary and information more effectively, particularly when using visuals to reinforce memory.

Lastly, the *Skill Code* focused on how mind mapping enhanced students' writing and cognitive abilities. As a preliminary tool, digital mind mapping helped students generate and organize ideas more effectively, making the writing process smoother and more coherent. The visual nature of mind maps allowed students to connect ideas and concepts, enhancing their logical reasoning and understanding of new material. This finding aligns with prior studies that suggest mind mapping fosters cognitive development by organizing thoughts logically and hierarchically.

Students could create well-structured essays with clearer content flow by visualizing their thoughts. The positive feedback from students emphasized that mind mapping enhanced their writing skills and motivated them to engage more actively in the learning process. The novelty of incorporating digital tools in elementary school education further highlights the significance of integrating technology into teaching practices to meet the demands of the digital age.

So, this study has demonstrated that digital mind mapping is a powerful tool for enhancing students' writing skills. Mind mapping allowed students to effectively recall, summarize, and organize information, improving their ability to write coherent and structured essays. Additionally, digital mind mapping fostered greater engagement with the learning material, making writing more enjoyable and less stressful for students. The study also highlighted the disparities between students regarding access to resources, with some students facing challenges due to unstable internet connections or lack of information search skills. Despite these challenges, the overall impact of digital mind mapping on students' writing skills was positive, suggesting that this method is highly effective in supporting students' cognitive and writing development in the digital era.

5. Conclusion

Implementing digital mind mapping techniques has significantly improved students' narrative writing skills, as demonstrated by the results from East Cilandak 01 Public Elementary School and Sasai Kandang 10 Public Elementary School. These findings confirm that digital mind mapping effectively encouraged students to organize and plan their writing, resulting in more coherent and structured narratives. The integration of digital tools like Canva in the classroom was well-received by students, who found the process enjoyable and beneficial in enhancing their writing abilities. Quantitative data further validated these positive outcomes, showing statistically significant improvements in students' post-test writing scores.

However, the study is not without its limitations. The reliance on Canva, a free and restricted tool, may have limited the full potential of digital mind mapping. Additionally, the research focused exclusively on writing skills, leaving other important areas, such as critical thinking and creativity unexamined. Future research could build on this study by incorporating a wider range of digital tools and exploring how mind mapping techniques might also foster the development of other cognitive skills in students.

The positive feedback from students and the significant improvement in their writing performance lay a strong foundation for future studies to refine and expand the use of digital mind mapping techniques in educational settings.

This conclusion aligns with the article’s emphasis on enhancing narrative writing through digital mind mapping and suggests opportunities for broadening the scope of educational research to include a variety of skills.

The manuscript’s novel contribution is the application of digital mind mapping in enhancing students' writing skills, specifically in the context of narrative writing. While mind mapping has been widely used in various educational settings, its integration with digital platforms like Canva in elementary education has not been explored extensively. This study presents a fresh perspective by combining cognitive and technological approaches to improving writing skills, offering practical insights for educators on how to use digital tools to enhance learning outcomes. This manuscript adds to existing knowledge by demonstrating the potential of digital mind mapping as a tool to improve writing skills in elementary school students. Previous studies on mind mapping have primarily focused on its use for organizing ideas and enhancing memory. However, this study extends that understanding by showing how mind mapping can be used to facilitate the writing process itself, improving both the cognitive and affective aspects of learning. It also highlights the challenges faced by students, particularly in rural areas, in utilizing technology and the importance of supporting students through such technological interventions.

The findings of this study suggest significant future implications for integrating digital tools into primary education. The use of digital mind mapping can be expanded beyond writing tasks to include other areas of learning, such as problem-solving, creative thinking, and collaborative learning. Furthermore, this research paves the way for future studies on the effectiveness of other digital tools in enhancing literacy and learning outcomes in diverse educational contexts. As digital learning continues to gain momentum, this research offers valuable insights into how schools can harness technology to foster more interactive, engaging, and effective educational experiences. It offers a unique intersection of cognitive science, educational technology, and literacy development, making it a relevant and timely piece.

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