Influence of Computer-Assisted Semantic Mapping on the Reading Performance of Grade 10 Students of San Francisco National High School

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Abstract: To address the concerning number of frustrated and non-reading high school students, this paper evaluates the potential of Computer-Assisted Semantic Mapping (CASM) to improve reading performance among Grade 10 learners. This experimental study aimed to measure the effectiveness of CASM on the reading skills of 60 Grade 10 students at San Francisco National High School. Due to the high number of frustrated readers, literacy adaptability was identified as a key area for improvement. Therefore, reading performance levels were assessed before and after the intervention using mean, frequency, and percentage analyses. To determine significant changes, statistical tests such as the t-test and paired t-test were applied. Results showed that CASM did not produce statistically significant improvements in reading comprehension, despite some observed increases in mean scores. This suggests that CASM may not effectively address reading gaps for Grade 10 learners but could be more beneficial for younger students, smaller class settings, or those with lower reading proficiency. CASM may be incorporated into various stages of lessons to build prior knowledge, and future researchers and educators may explore alternative hypertext or software interventions for e-semantic mapping to enhance its effectiveness further.

Keywords: *language learning, literacy, reading comprehension*

Introduction

Over the years, the Philippines has continued to develop strategies to cultivate essential skills that improve reading proficiency, which is widely recognized as a key to academic success. Recently, the 2018 Programme for International Student Assessment (PISA), which measures literacy performance across countries, including English, announced a sobering result. It found that 15-year-old learners scored an average of 340 points in reading comprehension, well below the international average of 487 points by a staggering 147 points, causing the country to rank last among the 79 participating nations. The reading abilities of Filipino pupils have been a challenge to educators and legislators. Despite government efforts to improve literacy rates, many Filipino students require assistance with reading comprehension (Idulog et al., 2023).

These alarming results reveal how COVID-19 widened learning gaps, leaving learners unable to meet basic literacy benchmarks. In response, the Department of Education (DepEd) has been implementing reading interventions to address the increasing number of students struggling to understand texts and those who are non-readers at the secondary level. Specifically, in the Division of Occidental Mindoro, out of 38,310 Grade 10 learners, 10,996 are identified as frustrated readers, including 2,281 frustrated readers and 95 non-readers. At San Francisco National High School, this issue is reflected in the School Improvement Plan, a 3-year plan developed by school teachers and the principal to determine strategies for addressing school needs. Under the Priority Improvement Plan focused on literacy adaptability, SIP reports that the school has identified 64 students who are frustrated readers and 102 students who are instructional readers.

On the other hand, while traditional strategies such as guided instruction on vocabulary and reading are widely used, their effectiveness has declined in a time when post-pandemic learning loss and digital distractions demand innovative teaching methods. This study examines technology-driven strategies that utilize frameworks to organize ideas and concepts, enhance vocabulary skills and mastery, and improve reading comprehension. CASM addresses

learners' affinity for digital tools in creating collaborative and interactive learning experiences. Al-Otaibi (2016) states that CASM enhances text comprehension and vocabulary acquisition by taking into account learners' digital literacy skills and promoting self-directed learning. However, there are still gaps in applying CASM for struggling readers in under-resourced schools in the Philippines, where limited access to technology and a lack of teacher training are significant barriers.

Moreover, this paper aims to address the gap by quantifying the effectiveness of CASM on Grade 10 learners at San Francisco National High School through the verification of whether CASM improves reading performance. This study aims to provide policymakers and educators with actionable insights to facilitate a thorough reassessment of the current curriculum, specifically in terms of reading materials and interventions employed. This also sought to equip educators better to alleviate learners' reading difficulties.

Research Questions

This study focused on the effect of CASM on the reading performance in English of Grade 10 students at San Francisco National High School. Specifically, this study aims to provide an answer to the following questions:

1. What is the level of reading performance of the experimental and control groups before and after the introduction of CASM in terms of word reading and comprehension level?

2. Is there a difference in the levels of reading performance in English between the control and experimental groups based on the pre-test and post-test results?

3. Is there a difference in the levels of reading performance in English between the pre-test and post-test results of the two groups?

Methodology

Research Design and Sample

Due to the nature of the problems in the study, a quasi-experimental design was used to determine the effectiveness of Computer Assisted Semantic Mapping (CASM) in improving the reading performance in English of Grade 10 students at San Francisco National High School. Sixty Grade 10 students participated, selected through purposive sampling. This method was used to ensure that the participants' groups had similar levels of reading performance at the start of the experiment. Two sections of Grade 10 were chosen, with one serving as the control group and the other as the experimental group. Then, simple random sampling was employed to select 30 students from each group, ensuring an equal opportunity for all students to participate as respondents in this study. A pretest was administered first to confirm that the control and experimental groups were equivalent and homogeneous. Once homogeneity was established, the first group was designated as the control, and the other as the experimental group, during which CASM was introduced. After the intervention, a post-test was conducted to measure the effect of CASM by comparing the results with the pre-test and between the two groups.

The present study aimed to determine whether there is a significant difference in CASM in the reading performance in English among the respondents. Specifically, this paper investigated the effectiveness of CASM on the respondents' reading performance in English. The study aimed to identify the semantic mapping skills of the respondents that significantly affect their reading performance in English. The variable CASM (IV) is expected to have a significant effect on the respondents' reading performance in English (DV). Reading performance will be based on the student's profile in the Phil-IRI program that their language teachers administered. The respondents in this study were 60 Grade 10 students from San Francisco National High School, comprising 30 students from Section A and 30 from Section B. It was expected that there would be 30 participants in the control group and 30 in the experimental group, with the experimental group receiving the CASM intervention and the control group receiving no interventions. The researcher chose Grade 10 as the respondents based on data from Phil-IRI DepEd Occidental Mindoro.

Data Collection and Instruments

Before gathering data, the researcher obtained permission from the division head, supervisor, and teacher-in-charge. After evaluating the CASM instrument and securing approval from the teacher-in-charge of the school, respondents were asked to bring their mobile phones before the experiment. Reading texts were provided, and online links were sent to their Messenger accounts for pre-tests and post-tests. Scores were easy to collect because the website app automatically checked answers and displayed scores immediately. This was administered on Tuesday during the respondents' second or third subjects, from 9:00 to 11:00 a.m., in the last week of the second quarter of the 2022-2023 academic year. Since the researcher distributed the digital pretest to all Grade 10 students, whether they were CASM respondents or not, only the scores of the 60 identified participants were recorded as data to evaluate the effectiveness of CASM on the respondents' reading performance.

The researcher used a website called "Wordwall.net" as the primary tool for the study. The platform promotes an immersive learning experience through engaging interactive activities accessible on both computers and mobile devices. Additionally, the instrument consists of 35 items divided into tests: Test 1 (items 1-3), Test 2a (4-7), Test 2b (8-10), Test 3 (11-15), Test 4a (16-18), Test 4b (19-23), Test 5a (24-26), Test 5b (27-31), and Test 6 (32-35). The reading materials vary, with Tests 1 and 2 featuring short reading passages, followed by an essay for Test 3. For Tests 4 and 5, participants read short stories, and Test 6 involves an essay. The test items are based on the cognitive dimension of Bloom's taxonomy, as outlined in the Table of Specifications from the Department of Education.

Data Analysis

To determine the reading performance levels of the respondents before and after the experiment, means and standard deviations were used. To assess whether there was a significant difference in the performances of the control and experimental groups at the start, an independent t-test analysis was conducted to ensure both groups had similar performance initially. The same statistical analysis was applied to evaluate differences in reading performance levels between the control and experimental groups after the experiment. Meanwhile, a paired t-test was employed to identify differences in English reading performance based on pre-test and post-test results within the groups.

Ethical Consideration

Per the school's policy of protecting students' information, the researcher drafted a memorandum of understanding among himself, the teacher-in-charge, the teachers, and the respondents. This document states that the dignity and well-being of the respondents will be protected at all times and that the research data will be handled with the utmost confidentiality throughout the study. Additionally, the researcher asked for the students' permission to use their real names in the survey. The participants' informed consent was also obtained, and they were told that they had the full right to refuse permission.

Results and Discussion

Level of Reading Performance in English of the Control and Experimental Groups Before the Introduction of CASM

The reading performance levels of both the control (mean score = 88.83, SD = 9.07) and experimental (mean score = 89.19, SD = 6.14) groups in English before the CASM intervention were at the frustration level for word reading. Likewise, in terms of comprehension, both the control group (mean score = 20.05, SD = 6.68) and the experimental group (mean score = 17.10, SD = 4.98) were at the developing level. This suggests that the respondents had similar abilities and that both groups were comparable before the treatment. The researcher believed that because both the control and experimental groups showed identical test scores before the experiment, the treatment was the only possible source of differences in outcomes between the groups. Regarding this, Thomas (2022) noted that a well-designed experiment ensures accurate measurement and valid results. This suggests that researchers can precisely assess the effect of a treatment when both groups start with the same capacities. He further added that all variables except the treatment must be kept constant. These findings also align with a recent study on the effectiveness of semantic mapping, specifically Maccagno (2019), which showed that using semantic mapping as a pre-reading strategy significantly improved the reading comprehension scores of English language students. In this context, Alghonaim (2020) explained the importance of pre-reading strategies, illustrating that EFL learners exposed to related activities outperformed the control group by 72% on comprehension tests (p < 0.01), highlighting the activation of prior knowledge.

Table 1. Level of reading performance in English of the control and experimental groups before the introduction of CASM.

Reading Performance in English	Control			Experimental		
	Mean Score	SD	Interpretation	Mean Score	SD	Interpretation
Word reading	88.83	9.07	Frustration	89.19	6.14	Frustration
Comprehension level	20.05	6.68	Developing	17.10	4.98	Developing

Level of Reading Performance in English of the Control and Experimental Groups After the Introduction of CASM

The reading performance levels of both the control (mean score = 89.86, SD = 7.76) and experimental (mean score = 89.25, SD = 7.45) groups remained at the frustration level for word reading after introducing CASM. Regarding comprehension, both the control group (mean score = 20.45, SD = 7.07) and the experimental group (mean score = 19.00, SD = 6.01) are at the developing level. This indicates that the mean scores of the experimental group (which received an intervention) and the control group (which did not) show little change, resulting in similar interpretations. Consequently, the researcher infers that the effectiveness of CASM could be better assessed if it were incorporated as activities across most stages of English lessons. This may lead to higher scores and an improvement in reading performance to a higher level. Therefore, integrating CASM into all stages of lessons throughout a grading period is deemed relevant.

These findings are supported by Liu et al. (2010), who state that thorough training on computer-assisted concept mapping requires time before its effects on reading can be observed. The researcher also notes that concept mapping involves extended practice, as supported by Yi et al.'s (2021) meta-analysis of 57 studies, which found that semantic mapping as a reading strategy requires coordinated and sustained application across affective, elaboration, monitoring, and organizational domains to produce transformative effects. The comparison of post-test outcomes between groups highlights the need for systematic integration of CASM throughout the curriculum stages. This aligns with Yi et al. (2021), who emphasize that the efficacy of semantic mapping depends on the simultaneous activation of strategies that complement CASM, such as metacognitive monitoring and vocabulary elaboration—strategies that isolated interventions failed to cultivate. These findings also reflect Supramaniam and Zainal's (2014) observation that the benefits of semantic mapping emerge through interactive application, especially considering that learners initially struggle to internalize the strategy.

Table 2. Level of reading performance in English of the control and experimental groups after the introduction of CASM.

Reading Performance in English	Control			Experimental		
	Mean Score	SD	Interpretation	Mean Score	SD	Interpretation
Word reading	89.86	7.76	Frustration	89.25	7.45	Frustration
Comprehension level	20.45	7.07	Developing	19.00	6.01	Developing

Difference in the Levels of Reading Performance in English of the Control and Experimental Groups Based on the Pre-Test Results

There is no difference in the English reading performance levels between the control and experimental groups based on the pre-test results. The respondents' pre-test scores do not differ in terms of word reading ($t = 0.554$, $p = 0.583$) and comprehension level ($t = 1.584$, $p = 0.122$). Therefore, the null hypothesis stating that there is no difference in the English reading performance levels of the control and experimental groups based on the pre-test results is accepted. Consequently, the homogeneity of the two groups, which is essential in experimentation, was established. It is relevant that a homogeneity test was conducted to determine whether the groups were similar in their English reading performance. According to Sari (2013), homogeneity is crucial to ensure that both control and experimental classes are comparable, as the similarity of the groups influences the test results. If the groups are not homogeneous, the treatment should not be continued because the classes differ in their ability to comprehend narrative texts successfully.

Furthermore, the study by Supramaniam and Zainal (2014) revealed that homogeneity in pre-test scores across groups is crucial for identifying effective strategies in reading comprehension gains. Similarly, Murphy et al. (2017) found that homogeneous pre-test reading results allow for a clearer attribution of post-intervention differences to the strategy used in discussion-based learning among fourth- and fifth-grade students. This aligns with Maccagno's (2019) quasi-experimental design regarding language instruction, where he used pre-test equivalence (Cohen's $d = 0.12$, $p = .62$) to demonstrate that the impact observed in the semantic mapping post-test was due to the intervention rather than initial group disparities. These related studies strongly support Sari's (2013) assertion that homogeneity testing is crucial in preventing confounds in educational research.

Table 3. Difference in the levels of reading performance in English of the control and experimental groups based on the pre-test results.

Reading Performance in English	Control		Experimental		t	p-value	Interpretation
	Mean Score	SD	Mean Score	SD			
Word reading	88.83	9.07	89.19	6.14	.554	.583	Not significant
Comprehension level	20.05	6.68	17.10	4.98	1.584	.122	Not significant

Difference in the Levels of Reading Performance in English of the Control and Experimental Groups Based on the Post-Test Results

There is no difference in the reading performance levels in English between the control and experimental groups based on the post-test results. However, the respondents' post-test scores in terms of word reading (t = 0.668, p = 0.508) and comprehension level (t = 0.217, p = 0.829) were statistically the same, despite an increase in the mean scores. This indicates that although there is an increase in the students' mean scores, their performances are statistically equivalent. Therefore, the null hypothesis, which states that there is no difference in the English reading performance levels of the control and experimental groups based on post-test results, is accepted. Based on the above results, it is implied that both the control and experimental groups demonstrate a high level of reading comprehension as measured by the CASM test. These findings are supported by the study of Liu et al. (2010), which investigated the impact of a computer-assisted concept mapping learning strategy on the English reading comprehension of EFL college students. The study found that poor readers showed significant improvement in their English reading skills and viewed concept mapping as a metacognitive strategy. However, no notable effect was observed for good readers.

Regarding word reading or oral reading, the researcher emphasized the importance of sounds, including pronunciation. The findings support Svenconis and Kerst's (2013) work, which explores the teaching of second language vocabulary through semantic mapping in a hypertext environment. It revealed that the experimental group, which used semantic mapping with sound, achieved the highest test scores. This supports the conclusion that developers of hypermedia programs should aim to design comprehensive, feature-rich systems. A key aspect of these programs is the sound factor, such as word pronunciation. The use of multimedia tools may also be explored to help learners develop their reading comprehension (Pesebre et al., 2024).

Furthermore, a study by Al-Jarf (2017) concluded that although semantic mapping interventions resulted in minimal score increases among respondents, the differences across groups were not statistically significant after a short intervention period. Zarie and Adami (2013) also found that semantic mapping strategies yielded only modest improvements in reading comprehension over limited durations, indicating the need for more prolonged exposure to produce measurable effects. Moreover, Farrokh and Tahmani (2018) conducted a study on Iranian students, which indicated that computer-assisted semantic mapping significantly improved reading comprehension, especially among low-performing readers compared to high-achieving learners. These findings suggest that while CASM can be effective, its impact may vary depending on instructional design, intervention length, and learner proficiency levels.

Table 4. Difference in the levels of reading performance in English of the control and experimental groups based on the post-test results.

Reading Performance in English	Control		Experimental		t	p-value	Interpretation
	Mean Score	SD	Mean Score	SD			
Word reading	89.86	7.76	89.25	7.45	.668	.508	Not significant
Comprehension level	20.45	7.07	19.00	6.01	.217	.829	Not significant

Difference in the Levels of Reading Performance in English of the Control Group Based on Pre-Test and Post-Test Results

There is no difference in the reading performance levels in English of the control group based on pre-test and post-test results in terms of word reading (t=.385, p=.703) and comprehension (t=.276, p=.784). Comparing the control group's performance before and after traditional instruction, there is no significant difference in word reading (t = 0.385, p = 0.703) or comprehension (t = 0.276, p = 0.784). This indicates that although the students' average scores increased, their performances remain statistically similar. Therefore, the null hypothesis, which states that there is no difference in the reading performance levels of the control group between the pre-test and post-test, is

accepted. This suggests that respondents may have prior knowledge of implementing CASM, which could affect their recall ability. As stated by Al-Otaibi (2016), the lack of connection between learners' post-test performances and their vocabulary understanding implies that word knowledge is not the only factor for successful text comprehension; prior knowledge is equally important. This conclusion is supported by an analysis of students' post-test scores, which showed that the experimental group made significant improvements compared to the control group. Maccagno (2019) explained that semantic mapping as a pre-reading strategy significantly enhanced learners' comprehension scores; however, its effectiveness depended on connecting new concepts to existing schemas and activating prior knowledge. This strongly supports the idea that a lack of previous knowledge limits the effectiveness of CASM.

Table 5. Difference in the levels of reading performance in English of the control group based on pre-test and post-test results.

Reading Performance in English	Before		After		t	p-value	Interpretation
	Mean Score	SD	Mean Score	SD			
Word reading	88.83	9.07	88.86	7.76	.385	.703	Not significant
Comprehension level	20.05	6.68	20.45	7.07	.276	.784	Not significant

Difference in the Levels of Reading Performance in English of the Experimental Group Based on Pre-Test and Post-Test Results

There is no difference in the reading performance levels of the experimental group in English based on pre-test and post-test results for word reading (t = .897, p = .375) and comprehension (t = 1.089, p = .283). Therefore, the null hypothesis, which states that there is no difference in the reading performance of the experimental and control groups based on pre-test and post-test results, is accepted. Furthermore, the researcher suggests that the characteristics of the experimental group may significantly influence the success of the intervention. According to Al-Otaibi (2016), metacognitive strategies such as CASM can be highly effective when administered in small classes, as this allows instructors to provide intensive training and detailed instruction on each student-created map. On the other hand, Ghyzayel (2013) also stated that learners need to experience instruction where language teachers extensively model and practice to fully benefit from CASM, especially in larger groups where individualized attention is limited.

Table 6. Difference in the levels of reading performance in English of the experimental group based on pre-test and post-test results.

Reading Performance in English	Before		After		t	p-value	Interpretation
	Mean Score	SD	Mean Score	SD			
Word reading	89.19	6.14	89.25	7.45	.897	.375	Not significant
Comprehension level	17.10	4.98	19.00	6.01	1.089	.283	Not significant

Conclusion and Recommendations

There was no significant improvement in reading performance for either the control or experimental groups in the pre-test and post-test results, despite the introduction of CASM, even though the groups were similar in all reading performance indicators before the intervention. CASM may be more suitable for learners with lower reading skills and could be more effective at earlier grade levels. Its implementation might need to be limited to fewer classes. Prior knowledge of CASM, integrated into different stages of lessons, is essential for better reading outcomes. Additionally, using other software that supports semantic mapping and hypertext CASM interventions was recommended. CASM may work better for students who struggle with reading, especially in lower grades, particularly

if used in fewer classes and combined with lessons that already incorporate the tool. Exploring other software options for supporting semantic mapping and hypertext interventions could also enhance reading development.

It is recommended that CASM be used with learners who have lower reading skills; additionally, it can be implemented at a lower grade level. The number of students participating in this study may be small, which could make the program's intervention more effective. Fewer respondents increase the chances that CASM will focus and concentrate its efforts, enhancing its efficiency. Therefore, it would be easier for teachers to make targeted interventions, such as providing intensive training for students, adjusting these interventions, and offering detailed explanations of each student-created map. Prior knowledge that influences learners' recall ability can be incorporated into CASM, thereby improving reading performance. CASM can be integrated into various stages of lessons, allowing students to build their background knowledge and ultimately achieve a better understanding of the content during e-mapping. Teachers are encouraged to involve students in semantic mapping activities within a hypertext environment, such as sound-based semantic mapping, which can lead to higher test scores and more practical activities and interventions. It is also recommended that teachers and future researchers develop computer-generated reading texts that include sound. Adding sound to semantic mapping can enhance learning development. Future researchers are suggested to explore other digital tools—both offline and online semantic software—that support the implementation and effectiveness of CASM. For teachers, it is advised to conduct multiple trials when using websites or software for CASM.

Conflict of Interest

The authors declare that there are no conflicts of interest between them. Both authors have ensured that their contributions to the study were conducted independently and without any external influences that could bias the results or interpretations. Neither author has any financial relationships with other individuals or organizations that could lead to inappropriate influence on their work, such as employment, consultancies, grants, or funding. The collaboration between the two authors was purely academic and aimed solely at advancing knowledge in the field without any potential for personal gain.

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Authorship Details

Alcantara (70%): Designing and conceptualization, comprehensive analysis, and manuscript writing.
Casanova (30%): Data interpretation, supervision, and editing the manuscript.

Use of AI Declaration

This research paper is free from AI-generated content, thus achieving a 0% AI score. However, to refine its grammatical accuracy and clarity, the paper underwent a thorough review process utilizing Grammarly. This AI-powered tool provided comprehensive feedback on grammar, punctuation, and style, ensuring the text met high standards of linguistic precision and readability.

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