Graphic organizers and the level of students' performance and self-efficacy in an online learning environment

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Abstract- Graphic organizers are research-based learning materials and approaches that help students understand a challenging subject. This study aims to see how graphic organizers influence students' performance and self-efficacy in the subject Science, Technology, and Society (STS) in an online setting. It was conducted at Quezon City University (QCU) in the first semester of Academic Year 2021–2022. It used a quasi-experimental study design technique known as the Pretest-Posttest Design. The results demonstrate that participants in the treatment group performed better than those in the control group. After obtaining lessons and learning using various graphic organizers, the subjects in the control group improved their degree of self-efficacy. The study concludes that graphic organizers seemed to influence students' performance and level of self-efficacy in STS. Teachers should use visual organizers to help students enhance their academic accomplishment and self-efficacy, particularly in an online learning setting..

Index Terms- Graphic organizers, Online learning environment, Students' performance, Self-efficacy, Science, Technology, and Society (STS)

I. INTRODUCTION

The COVID-19 pandemic caused a sudden shift in learning mode from face-to-face learning to online and distant learning. There are studies that have been conducted in the past about the usefulness of online courses (Boykin, et al. 2019; Kwon, Shin, & Park, 2018; Ponce, et al. 2018). However, most of these concentrate on comparing traditional classrooms to online classrooms (Boykin, et al. 2019; Kwon, Shin, & Park, 2018; Ponce, et al. 2018), but little research on what effective instructional learning materials and activities are suitable for this kind of learning environment to ensure the promotion of student satisfaction and academic achievement.

According to Kurniaman et al. (2018), when appropriate instructional learning materials are chosen and incorporated into each lesson, students' performance improves. Furthermore, studies support the claim that relevant and appropriate instructional learning materials do improve students' performances because they directly support the presenting and gathering of facts, principles, and concepts in class (Kaku & Arthur, 2020; Nja et al. 2020; Taculod & Arcilla, Jr., 2020). In addition, the use of appropriate instructional learning materials, whether in a regular face-to-face class (Kaku & Arthur, 2020) or in an online learning space (Yilmaz & Korur, 2021), helps the learners to establish schemas that extend their working memory so that they can understand and learn more difficult information (Chairilysha & Kurnia, 2018). And lastly, with the use of suitable instructional learning materials, students become more engaged and motivated to learn, according to Nasir, Prastowo, and Riwayani (2018). As a result, in order to have the greatest impact, such materials must be carefully planned, selected, organized, refined, and used in a course (Garzon-Diaz, 2021).

Research-based learning materials and strategies that help students learn complex content (Kurniaman & Zufriady, 2019).It is a non-linguistic, visual tool that enables the learner to connect new information to their existing knowledge and see how concepts relate to each other and fit in, which in turn makes them recall information easily (Kurniaman & Zufriady, 2019).

The spatial arrangements of graphic organizers allow the students to identify the missing information or absent connections in one's strategic thinking (Ellis, 2015). According to Condidorio (2010), graphic organizers facilitate student comprehension of science content by showing the interrelatedness of ideas; providing visual cues to help students process the information; and allowing students to direct their own learning by keeping graphic organizers open to interpretation and independent thinking. In fact, dozens of empirical studies were conducted to verify the efficacy of such organizers, and some of these studies asserted their viability for teaching science subjects (Atomatofa, 2013; Chuang, & Liu, 2014; Dexter, Park, & Hughes, 2011; Omondi, Keraro, & Anditi, 2018; Wachanga, Arimba, & Mbugua, 2013). It is found that these organizers help the students visualize the abstract ideas, divide the writing tasks into smaller palatable parts, and monitor

their writing progress (Prihandoko, Slamet, & Winarno, 2018; Suarman & Hikmah, 2018).

In a study conducted by Wang et al. (2020) on the benefits of interactive graphic organizers in online learning, it was revealed that graphic organizers helped students perform better on their test performance and improved students' satisfaction with learning. In addition, the interactive graphic organizers helped increase the students' generative cognitive processes and helped them create graphic organizers in new situations. The study points to the potential of interactive graphic organizers as a tool for priming generative learning strategies in learners. In addition, Ponce et al. (2018) claimed that when graphic organizers are incorporated into a computer-based learning methodology, students' short-term and long-term memories improve.

While graphic organizers improve students' performances, they also improve the level of students' self-efficacy (Eissa, 2012). According to Bandura, as cited by Zimmerman (2015), self-efficacy is a person's perception of his or her ability to complete a task successfully. Additionally, Bandura stated that perceived self-efficacy is concerned with what you believe you can do with the skills you possess in a variety of situations (Olave, 2019; Zimmerman, 2015). Self-efficacy is task-specific, in contrast to other, more general constructs such as self-concept or self-esteem (Olave, 2019; Zimmerman, 2015). Self-efficacy is frequently attributed to four sources of influence: personal experiences, observation of others, physical status, and feedback from others (Panc, Mihalcea, & Panc, 2012; Schunk, 2012).

Self-efficacy has been examined in a range of circumstances, and the findings of self-efficacy research have been consistent across contexts in terms of the relationship between self-efficacy and behaviors (Zimmerman, 2015). When confronted with a difficulty, people with higher levels of confidence were more likely to engage in related actions (Alexander, 2013). Educational psychologists are fascinated with self-efficacy because of its links to motivation, perseverance, performance, and self-regulation (Olave, 2019; Zimmerman, 2015).

Despite the success of using graphic organizers in class (Balasundram & Karpudewan, 2020; Bucayong, 2019; Bucayong & Ong, 2018), there are still areas that need to be clarified, like the influence of graphic organizers in improving the level of self-efficacy of students in an online learning environment, especially in science classes like Science, Technology, and Society (STS) subject at the tertiary level. STS is a new subject in many countries' curricula (Primastuti & Atun, 2018), and because it is new, there are no studies that have particularly looked at students' academic achievement in the subject, especially when it is conducted in an online learning environment.

In general, however, literature indicates that students' performance in science subjects continues to wane, owing to students' negative views toward traditional science, science classes, and science teachers (Li, 2019; Li, 2018; Lin, et al. 2019; Margot & Kettler, 2019; Thibaut, et al. 2018). As a result, researchers investigate how graphic organizers improve students' performance in STS subjects in an online learning environment and how it influences students' level of self-efficacy. Specifically, this study attempts to: describe the performance of the students before and after receiving traditional learning instructions and learning instructions with different types of graphic organizers; find out the difference between the performance of the students in STS after receiving traditional learning instructions and learning instructions with different types of graphic organizers; describe the level of self-efficacy of the students before and after receiving instructions that utilize different types of graphic organizers; and find out the difference in the level of their self-efficacy before and after receiving instructions and learning with different types of graphic organizers.

Considering the research objectives, the researchers hypothesize that there is no significant difference in the performance of the students who received traditional learning instructions and students who received learning instructions with different types of graphic organizers in STS subject in an online learning environment before and after the conduct of the study; there is no significant difference in the level of self-efficacy of the students who received learning instructions with different types of graphic organizers in STS subject in an online learning environment before and after the conduct of the study; and there is no significant difference in the level of self-efficacy of the students who received learning instructions with different types of graphic organizers in STS subject in an online learning environment before and after the conduct of the study.

II. METHODOLOGY

The theoretical premises of the study include the dual-coding theory (Paivio, 1971) and the self-efficacy theory (Bandura, 1977).

According to the dual-coding theory, verbal associations and visual imagery are the two ways a person can expand on learned material (Paivio, 1971). According to Paivio (1971), both visual and verbal information are used to represent information. Visual and verbal information are processed differently and along distinct channels in the human mind, creating separate representations for information processed in each channel. The mental codes corresponding to these representations are used to organize incoming information that can be acted upon, stored, and retrieved for subsequent use. Both visual and verbal codes can be used when recalling information (Paivio, 1971).

On the other hand, self-efficacy is a person's belief in their ability to succeed in a particular situation (Bandura, 1977). According to Bandura (1977), one's sense of self-efficacy can provide the foundation for motivation, well-being, and personal accomplishment.

The researchers' use of dual-cognitive theory and self-efficacy theory helped them visualize and conceptualize the study. Since the study primarily aims to establish the influence of graphic organizers on students' performances, the dual-coding theory of Paivio (1971) allows the researchers to understand how an individual could expand on learned materials. The self-efficacy theory of Bandura (1977) guided the researchers in presenting graphic organizers in a way that encouraged students to participate and complete the tasks during the conduct of the study.

The study was conducted at Quezon City University (QCU) during the First Semester of the Academic Year 2021–2022. The study utilized first-year Bachelor of Science in Accountancy (BSA) students from QCU to determine the influence of graphic organizers on students' performances and self-efficacy. They were officially enrolled in the subject STS during the First Semester of the Academic Year 2021–2022 at the University. The study used a convenient sampling technique to obtain the sample size due to the restrictions imposed by the Inter-Agency Task Force (IATF) for the Management of Emerging Infectious Diseases in the Philippines on movement and activities during the COVID-19 pandemic.

A total of seventy (70) participants were involved in the study, and they were divided into two groups (Control and Treatment) with thirty-five (35) students each.

The study adopted the quasi-experimental research design technique (Fraenkel, Wallen, & Hyun 2019), specifically, the Pretest-Posttest Design. First, the primary researcher asked the approval of the Quezon City University Office of the Vice President for Research, Extension, Planning, and Linkages (QCU-REPL) to conduct the study, and after the approval, the researcher emailed the Informed Consent Letter and Informed Consent Form to the subjects via Google Forms. When the subject completed and signed the Informed Consent Form and returned it to the primary researcher, the formal experiment began immediately.

The experiment lasted for six (6) weeks. It started on October 9, 2021 and concluded on November 13, 2021. The pre-test was given to the subjects in both groups during the first week of the experiment. It includes sixty (60) multiple-choice items, where each of which is worth one (1) point and requires a working knowledge of fundamental definitions and concepts ranging from simple to complex and distributed into three cognitive levels based on a modified version of Bloom's taxonomy: Knowledge, Understanding and Application, and Higher Mental Process. The General Self-Efficacy Scale (GSES) was given only to the subjects in the treatment group. The GSES was adopted from the Generalized Self-Efficacy Scale by Schwarzer and Jerusalem (1995). The items were modified to suit the objectives of the present study, which includes ten (10) items of structured statements in a Likert format. The self-efficacy of the subjects in the treatment group was interpreted using the mean score computed from their responses on the Likert Scale.

Science and Technology and Nation Building; The Human Flourishing; The Good Life; The Information Age (Gutenberg to social media); Biodiversity and Health Society; and Genetically Modified Organisms: Science, Health, and Politics were taught for six weeks in an online learning environment using the lecture-discussion method. However, the subjects in the treatment group received lecture and discussion of the topics with the addition of several graphic organizers in various parts of the session, such as motivation, activity, summary, assessment, and assignment.

On the sixth week of the experimental procedure, a post-test was administered to both groups to determine their performances. On the other hand, the GSES instrument was given to the subjects in the treatment group after the experiment since they were the group who were exposed to the use of graphic organizers. In this way, the researchers were able to clearly establish the influence of graphic organizers on the subjects' self-efficacy.

After the retrieval of the research instruments, the responses of the subjects were processed using IBM SPSS Statistics version 22 statistical software. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to interpret the subjects' performances and self-efficacy. Likert scales were used to describe the results and supplement the interpretation derived from the collected data. The difference in individuals' performance in the post-test between the control and treatment groups after the experiment was determined using an independent sample t–test at the 0.05 level of significance.

III. RESULTS AND DISCUSSION

Performance of the subjects before and after receiving traditional learning instructions and learning instructions with different types of graphic organizers

Table 1 shows the over-all mean of the control (M = 20.20, SD = 7.52) and treatment (M = 20.23, SD = 7.56) groups in the pretest given to them. As shown in the table, before receiving the traditional method (lecture and discussion), most of the subjects in the control group failed the test given to them. A total of twenty-five subjects out of thirty-five subjects, or 71.42 percent, in the control group got a score that was less than 25 points. There are only five, or 14.29 percent, of the subjects who got a score between 25 and 30 points and are described as "Improve," while the same number of subjects got a score between 31 to 36 points, which is classified as "Pass."

On the other hand, before receiving instructions and learning using various types of graphic organizers, most of the subjects in the treatment group got "Failing" scores on the pre-test given to them. Most of the subjects, or a total of twenty-six subjects out of thirty-five, or 74.29 percent, got a score that is less than 25 points, which is interpreted as "Fail". There are only five, or 14.29 percent, of the subjects who got a score between 25 and 30 points and were described as "improved," while four subjects in the treatment group got a score between 31 to 36, which is classified as "Pass."

Table 1

Pre-test and post-test results of the subjects before and after receiving traditional learning instructions and learning instructions with different types of graphic organizers

Range of Scores	Description	Control Group				Treatment Group			
		Pretest Mean = 20.20, SD = 7.52		Posttest Mean = 23.00, SD = 7.25		Pretest Mean = 20.23, SD = 7.56		Posttest Mean = 31.06, SD = 6.60	
		f	%	f	%	f	%	f	%
55 – 60	Excellent	0	0	0	0	0	0	0	0
49 – 54	Very Good	0	0	0	0	0	0	0	0
43 – 48	Good	0	0	0	0	0	0	0	0
37 – 42	Moderate	0	0	3	8.57	0	0	7	20.00
31 – 36	Pass	5	14.29	4	11.43	4	11.42	9	25.71
25 – 30	Improve	5	14.29	7	20.00	5	14.29	16	45.71
Less than 25	Fail	25	71.42	21	60.00	26	74.29	3	8.58

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After receiving the traditional method of teaching, subjects in the control group somehow improved their over-all performances, as revealed by their over-all mean (M = 23.00, SD = 7.25) as shown in Table 1. However, the majority (21 or 60%) of the subjects got a failing score, which is less than 25. Meanwhile, there are a few (7 or 20%) who got a score which is in between 25 to 30 points and described as "Improve". Four or 11.43 percent of the subjects got a passing score of 31 to 36 points, and only three (8.5 percent) got a "Moderate" score between 37 to 42 points. While the subjects in the treatment group show an improvement in their overall performances, as revealed by the overall mean of the post-test given to them (M = 31.06, SD = 6.60) as shown in the table. Fewer than half of the subjects in the treatment group, or 45.71 percent, got a score ranging from 25 to 30 points, which is described as "Improve", while 25.71 percent got a passing score between 31 to 36 points, which is interpreted as "Pass", and 20 percent got a score between 37 to 42 points, which is construed as "Moderate". While there are only three, or 8.58 percent, in the treatment group, got a failing score, which is less than 25 points.

Data revealed that subjects in the control group who are subjected to the traditional lecture discussion method show a slight improvement in their performance in the class. It was observed that during the lecture discussion, students get direct feedback from the teacher. And thus, it is expected that they performed better after the duration of the experiment, as manifested in the results of their post-test exam. However, it was also observed that some students during the lecture-discussion manipulate the entire discussion while others remain passive during the discussion. Thus, it can be related to the result of the post-test, where there is a smaller number of subjects who got "pass" or "moderate" scores. Also, it was observed that subjects with limited communication abilities in the control group could not participate in the discussion.

The traditional lecture-discussion method used in the control group was found to be slightly effective at improving the subjects' overall performance, as revealed by the results of their post-test. The result is congruent with studies comparing the lecture-discussion method with other teaching and learning strategies (Avila, 2020; Mutrofin, et al. 2017; Smale-Jacobse, et al. 2019), where the traditional method of teaching slightly improves the performance of the students. By comparing the means before and after the traditional lecture discussion, students' engagement still increased using this kind of method. The results can also be interpreted that the traditional lecture-discussion method improves students' ability to think creatively and at the same time strengthens their existing cognitive structures.

On the other hand, data revealed that the combination of the lecture discussion method and the use of graphic organizers as learning instructional material directly improves the subjects' performances. During the experiment, the teacher maximized the use of graphic organizers by asking questions that require reasoning, analyzing, and evaluating, such as "why and how" instead of "what". It was observed that when graphic organizers are used as part of the lecture-discussion to present concepts, it allows students to actively participate and permits them to carefully analyze the relationships among concepts and relate them to their previous knowledge or constructs.

The result of the post-test is not surprising to the researchers because it was observed that during the experiment, when the teacher uses graphic organizers as part of the lecture-discussion and even as part of the motivational strategy, graphic organizers help the subjects focus on a particular concept and avoid irrelevant answers or ideas. Graphic organizers also permit a tactful way of accepting doubtful answers that encourages students to participate in the discussion. Similarly, the results agree with the study conducted by Balasundram and Karpudewan (2020), Bishop et al. (2015), Bucayong (2019), Bucayong and Ong (2018), Ilter (2016), and Lingaiah and Dhanapal (2020) that when graphic organizers are given or incorporated in class, students perform better as compared with their initial performances in class after using the material.

Furthermore, it was discovered that graphic organizers help students perform better because they carefully guide the discussion by allowing the teacher to ask questions at various points and provide clues to keep it on a clear and smooth flow of discussion. Also, with the use of graphic organizers, it avoids the "continuous talk" of the teacher during the lecture-discussion, which may sound boring to some students.

The results indicate that whenever an instructional intervention, like the use of graphic organizers, is given to students, they perform better after receiving such an intervention. According to Myers and Savage (2005), instructional materials like graphic organizers promote comprehension and aid in students' learning with complex content, and so it does as reveal in the results of the subjects' post-test results. And lastly, after utilizing various types of graphic organizers in class, subjects in the treatment group improve their performance. It allows students to reason out, analyze, and evaluate concepts presented to them. Graphic organizers help them to organize their thoughts and ideas and relate them to previous concepts in a way that helps them perform better on the post-test given to them.

Performance of the subjects in STS after receiving traditional learning instructions and learning instructions with different types of graphic organizers

Result shows that the scores in the treatment group (M = 31.06, SD = 6.60) is significantly different from scores in control group (M = 23.00, SD = 7.56) as revealed by the result of the independent sample t-test, $t(68) = -4.749$, $p < 0.001$ presented in Table 2.

Table 2.

Difference between the performance of the subjects in STS after receiving traditional learning instructions and learning instructions with different types of graphic organizers

Groups	Mean	SD	df	t	p-value
Control	23.00	7.56	68	-4.749*	.000
Treatment	31.06	6.60			

The data indicates that instruction and learning with various types of graphic organizers has a direct effect on students' performance. When the post-test results from the two groups were compared, subjects in the treatment group outperformed their counterparts in the control group. This is because, when using the lecture-discussion method, those with superior communication skills tend to monopolize the discussion. Additionally, when the lecture method is used indefinitely without any form of learning activity or the incorporation of a variety of instructional learning materials or strategies, the session tends to become boring, especially for learners with a short attention span.

The significant difference in mean scores of the post-test between the control and treatment groups demonstrates that graphic organizers help subjects develop their capacity to draw on prior knowledge to become independent readers, active citizens, and problem solvers of complex problems. Graphic organizers enable subjects to construct the processes associated with teaching and learning, which ultimately improves their performance. Additionally, one could argue from the findings that subjects develop autonomy and the capacity for complex thinking because of the deliberate design and implementation of graphic organizers. Additionally, observations made during the experiment indicate that various types of graphic organizers, such as tree maps, concept maps, Venn diagrams, semantic organizers, and the Frayer model, can be used effectively in a variety of contexts and different parts of the lesson. Notably, the results indicate that graphic organizers can aid subjects in deconstructing information into smaller categories in order to make inferences. Also, the findings indicate that subjects can benefit from the use of graphic organizers in an online learning environment, in small groups, or independently.

As previously mentioned, graphic organizers are pictorial ways of constructing knowledge based on existing knowledge and organizing complex information in a simple-to-understand manner in the mind (Degrano, 2017). The above results reaffirm the views of Marzano et al. (2001) that, as students complete graphic organizers and socially interact with their peers, they develop creative and critical thinking skills. The net result is the occurrence of meaningful learning, which enhances their ability to transfer classroom knowledge to real-life situations (Marzano et al., 2001). The significant difference in the performance of the subjects after the experiment supports the claims of Ajverdi, Nakibogu, and Aydin (2014) and Vallori (2014) that graphic organizers show how concepts are linked to prior knowledge to aid in understanding, improve memory, retain information, and increase students' understanding and insight into the topic. Furthermore, the study conducted by Khamkhong (2018) revealed that after receiving training, developing, and implementing graphic organizers, an increase in the students' test scores was funded, which is like the results of this study. Thus, the findings assert that when utilized properly, graphic organizers are useful and effective in improving students' performances in class.

With the results, the null hypothesis that there is no significant difference in the performance between the two groups of subjects after receiving traditional instruction and after receiving instruction and learning using various types of graphic organizers is rejected.

Level of self-efficacy of the subjects before and after receiving instructions that utilize different types of graphic organizers

The over-all self-efficacy level of the subjects before receiving instructions that utilize different types of graphic organizers is described as "somewhat confident," with a computed over-all mean value of 2.95 and a standard deviation of 0.18 (see Table 3). As we gleaned from the table, respondents described their self-efficacy level as "somewhat confident" when it comes to their ability to apply STS concepts in addressing issues of climate change (M = 3.20, SD = 0.53), awareness of the positive and negative implications of nanotechnology to society (M = 3.11, SD = 0.83), and in determining the relationship between society, environment, and health (M = 3.09, SD = 0.74). In addition, the subjects said that they are "somewhat confident" when it comes to their ability to discuss and share with others the ethics and implication of GMO's (M = 2.97, SD = 0.71), being aware of the importance of biodiversity to the human race and to the development of society (M = 2.94, SD = 0.76) and of the potential future impacts of Genetically Modified Organisms (GMOs) on agriculture and crop production (M = 2.91, SD = 0.66), and being aware of the current situation of the world's climate and its changing state (M = 2.91, SD = 0.78) before using graphic organizers in class.

Subjects also said that they are "somewhat confident" when it comes to their ability to discuss the major impacts of nanotechnology on society confidently (M = 2.89, SD = 0.68), straightforwardly link the information or concepts that they have learned to the development of the information age and its impact on society (M = 2.83, SD = 0.82), and ability to illustrate how the social media and the information age have impacted our lives (M = 2.63, SD = 0.65) as revealed by the General Self-Efficacy survey before the experiment.

The results indicate that the self-efficacy of the subjects in the treatment group is not affected by any intervention or instructional learning materials like the graphic organizers before the experiment. Thus, any change in the subjects' level of self-efficacy after the treatment is somehow attributed to the intervention or instructional learning material used.

Table 3

Self-efficacy of the subjects in the treatment group before and after receiving instructions that utilize different types of graphic organizers

General Self-Efficacy Scale Item	Before Instruction			After Instruction		
	Mean	SD	Description	Mean	SD	Description
1. I can	2.83	0.82	Somewhat	3.60	0.69	Fairly

straightforwardly link the information or concepts that I have learned to the development of the information age and its impact to society.			Confident			Confident
2. I am completely able to illustrate how the social media and the information age have impacted our lives.	2.63	0.65	Somewhat Confident	3.80	0.72	Fairly Confident
3. I can easily determine the relationship between society, environment, and health.	3.09	0.74	Somewhat Confident	3.91	0.78	Fairly Confident
4. I am fully aware of the importance of biodiversity to human race and to the development of the society.	2.94	0.76	Somewhat Confident	4.14	0.77	Fairly Confident
5. I am able to discuss and share to others the ethics and implication of Genetically Modified Organisms (GMO's).	2.97	0.71	Somewhat Confident	4.09	0.78	Fairly Confident
6. I am completely aware of the potential future impacts of Genetically Modified Organisms (GMOs) to agriculture and crop production.	2.91	0.66	Somewhat Confident	3.86	0.77	Fairly Confident
7. I am confidently able to discuss the major impacts of nanotechnology on society.	2.89	0.68	Somewhat Confident	3.80	0.80	Fairly Confident
8. I am fully aware of the positive and negative implications of nanotechnology to society.	3.11	0.83	Somewhat Confident	4.00	0.77	Fairly Confident
9. I am fully aware of the current situation of the world's climate and its changing state.	2.91	0.78	Somewhat Confident	3.83	0.66	Fairly Confident
10. I can apply STS concepts in addressing issues of climate change.	3.20	0.53	Somewhat Confident	3.91	0.74	Fairly Confident
Pooled Mean	**2.95**	**0.18**	**Somewhat Confident**	**3.89**	**0.21**	**Fairly Confident**

After receiving instructions using different types of graphic organizers, the subjects in the treatment group said that the level of their self-efficacy is "fairly confident," with a computed over-all mean value of 3.89 and a standard deviation of 0.21 as shown in Table 3. Specifically, respondents said that after exposure to various types of graphic organizers they become "fairly confident" after being exposed to various types of graphic organizers when it comes to being aware of the importance of biodiversity to the human race and to the development of society (M = 4.14, SD = 0.77), the ability to discuss and share with others the ethics and implications of genetically modified organisms (GMO's) (M = 4.09, SD = 0.78), and being fully aware of the positive and negative implications of nanotechnology to society (M = 4.00, SD = 0.77).

Moreover, Table 3 revealed that the subjects under the treatment group said that they have become "fairly confident" when it comes to their ability to apply STS concepts in addressing issues of climate change, and they can easily determine the relationship between society, environment, and health (M = 3.91, SD = 0.78) after utilizing the different types of graphic organizers in class. Lastly, the results of the GSES rating scale given to the subject under the treatment group after being exposed to various graphic organizers revealed that the level of self-efficacy of the subject when it comes to being completely aware of the potential future impacts of Genetically Modified Organisms (GMOs) to agriculture and crop production (M = 3.86, SD = 0.77), being fully aware of the current situation of the world's climate and its changing state (Mean = 3.83, SD = 0.66), being able to discuss the major impacts of nanotechnology on society confidently (M = 3.80, SD = 0.80), being able to illustrate how the social media and the information age have impacted our lives completely (M = 3.80, SD = 0.80), being able to illustrate how the social media and the information age have impacted our lives completely (M = 3.80, SD = 0.72), and being able to link the information or concepts that they have learned to the development of the information age and its impact on society straightforwardly (M = 3.60, SD = 0.69) is "fairly confident".

It can be gleaned from the data that graphic organizers directly affect the level of self-efficacy of the respondents. This is true because during the treatment, subjects in the treatment group showed an interest in using graphic organizers as part of individual and group activities as well as during formative assessment. As observed, they were highly engaged in developing their own organizers, especially when they presented their individual work in class. The creativity of the students during the presentation was expressed. They were also able to articulately express their own ideas when they were asked to present their work in class.

Furthermore, it was observed that the subjects in the treatment group were confident enough to answer the teachers' questions with the help of their personally made graphic organizers. Online classroom discussions become lively and interactive as the subjects participate during the presentation of their work. They were able to answer the "why" and "how"

questions during the discussion. And it is evident that their confidence improves as the lesson progresses using graphic organizers.

The results reflect how graphic organizers develop confidence among the subjects in the treatment group during the experiment. Data showed that after using graphic organizers, subjects became "fairly confident" about the topics presented to them, compared to their reported level of self-efficacy prior to the experiment. This is because, primarily, graphic organizers tend to help the subjects with visualizing and constructing ideas, organizing complex ideas, and sequencing available information. It was also observed that when the students use the graphic organizers as part of their presentation and formative assessment, they learn how to plan what to write, increase their reading comprehension, initiate brainstorming among group members, organize problems and solutions, compare ideas, show cause and effect, and many more.

Additionally, since graphic organizers help the subjects organize their thoughts and ideas and present them as a single concrete idea, they gain the confidence to share what they know. As observed during the experiment, students also learn how to accept their mistakes and show their willingness to eliminate information or concepts that are not relevant to the discussion.

Based on the results, the level of self-efficacy of the subjects in the treatment group improved after they were exposed to various types of graphic organizers in class. This is consistent with the idea of Alexander (2013), where she asserted that when confronted with a difficulty, people with higher levels of self-efficacy were more likely to engage in related actions (Alexander, 2013). Thus, as the subjects in the treatment group are continuously exposed to the different types of graphic organizers which they need to answer, they become more engaged in the task and their performance in the class increases (Olave, 2019; Zimmerman, 2015). The results also confirm the findings of Eissa (2012) on his study about the effect of using advanced graphic organizers on academic achievement, self-efficacy, and motivation to learn social studies in learning disabled second-year prep students.

As revealed in the results of the GSES rating scale given to the subjects in the treatment group after the experiment, graphic organizers improve students' self-efficacy towards learning. The results suggest that utilizing various types of graphic organizers and maximizing their potential use in class helps to improve students' self-efficacy, motivation, and performance.

Difference in the level of self-efficacy of the subjects before and after receiving instructions and learning with different types of graphic organizers

Table 4 shows the difference in the level of self-efficacy of the subjects before and after receiving instructions and learning with different types of graphic organizers. Data indicate that the level of self-efficacy of subjects in the treatment group ($M = 2.95$, $SD = .181$) prior to treatment is significantly different than the level of self-efficacy following treatment ($M = 3.89$, $SD = .210$), $t(68) = -4.749$, $p < 0.001$.

Table 4

Difference in the level of self-efficacy of the subjects in the treatment group before and after receiving instructions and learning with different types of graphic organizers

Self-efficacy	Mean	SD	Df	t	p-value
Before	2.95	.181	68	-20.208*	.000
After	3.89	.210			

The results argue that when the treatment group was exposed to various types of graphic organizers in class, their self-efficacy increased. In other words, instruction and learning that incorporates various types of graphic organizers have been shown to increase students' self-efficacy.

As evidenced by the significant difference in mean scores between the treatment and control groups following the experiment, graphic organizers increase students' self-efficacy for learning. The findings indicate that incorporating a variety of graphic organizers and maximizing their potential for use in class can help students' self-efficacy, motivation, and performance.

Data indicates that graphic organizers have a direct effect on respondents' self-efficacy. This is because subjects in the treatment group demonstrated an interest in using graphic organizers as part of individual and group activities, as well as during formative assessment throughout the treatment. They were extremely engaged in developing their own organizers, which is especially important when they present their individual work in class. Throughout the presentation, the students' creativity was demonstrated. Additionally, they were able to articulate their own ideas when asked to present their work in class. In addition, it was observed that the subjects in the treatment group were confident in their ability to respond to the teachers' questions using their self-created graphic organizers. As subjects participate in the presentation of their work, classroom discussions become lively and interactive. Throughout the discussion, they were able to respond to the "why" and "how" questions. And it's clear that their confidence grows as the lesson progresses using graphic organizers.

The results demonstrate how graphic organizers foster confidence in subjects in the treatment group over the course of the experiment. The data revealed that after using graphic organizers, subjects developed a "fairly confident" attitude toward the topics presented to them, compared to their pre-experiment level of self-efficacy. This is because graphic organizers assist subjects in visualizing and constructing ideas, organizing complicated ideas; and sequencing available information. Additionally, it was observed that when students use graphic organizers as part of their presentation and formative assessment, they learn how to plan what to write, improve their reading comprehension, initiate group brainstorming, organize problems and solutions, compare, and contrast ideas, and demonstrate cause and effect, among other skills.

Additionally, because graphic organizers assist subjects in organizing their thoughts and ideas and distilling them into a single concrete concept, they gain confidence in sharing what they have learned. As demonstrated during the experiment, students also learn how to accept their mistakes and demonstrate their willingness to omit irrelevant information or concepts from the discussion.

The findings of this study confirm the relationship of self-efficacy with behavior (Zimmerman, 2015), as the subjects' self-efficacy improved when they were exposed to activities that required higher-order thinking using graphic organizers. The findings support Alexander's (2013) hypothesis that people with higher levels of self-efficacy are more likely to engage in related actions when confronted with a challenge (Alexander, 2013). As the treatment group's subjects are continually exposed to the various types of graphic organizers that they must complete, they become more engaged in the task and their class performance improves (Olave, 2019; Zimmerman, 2015).

Furthermore, the findings back up Eissa's (2012) findings on the impact of advanced graphic organizers on academic achievement, self-efficacy, and motivation to learn social studies in learning disabled second-year prep students. As a result, the findings suggest that graphic organizers should be used to improve students' achievement, self-efficacy, and motivation to learn science topics.

Based on the given findings, the null hypothesis that there is no significant difference in the level of self-efficacy between subjects in the treatment group before and after receiving instructions and learning using various types of graphic organizers is rejected.

IV. CONCLUSION

Based on the results of the study, the researchers found that most of the subjects in the control group failed the test in STS given to them before receiving the traditional method of teaching, and a slight improvement in their performances was observed after the procedure. Similarly, most of the subjects in the treatment group failed the test in STS given to them before receiving instructions and learning with different types of graphic organizers. However, after the procedure, subjects in the treatment group improved their overall performance on the test given to them. While comparing the results of the post-test given to the two groups, subjects in the treatment group performed better as compared to the performances of the subjects in the control group. It can be argued that graphic organizers seemed to influence the performance of subjects more in STS than in the traditional way of instruction.

Furthermore, most of the subjects in the treatment group had a low level of self-efficacy before receiving instructions and learning using various types of graphic organizers. However, an improvement in the level of their self-efficacy is seen after receiving instructions and learning using various types of graphic organizers. Subjects in the treatment group demonstrated a significant difference in self-efficacy before and after receiving instructions and learning using various types of graphic organizers in ST. The level of the subjects' self-efficacy significantly improved after receiving instructions and learning utilizing different types of graphic organizers. Graphic organizers seemed to influence the level of the subjects' self-efficacy in STS.

From the significant findings and conclusions of the study, it was recommended that students make a greater effort to improve their grades. On the other hand, teachers should innovate traditional instructional strategies by incorporating research-based instructional materials that support student learning and achievement, as well as the overall teaching and learning process. They should make a more concerted effort to improve their academic performance. Conversely, teachers should utilize a variety of instructional learning materials, such as graphic organizers, to help students improve their academic achievement and learning performance.

In addition, graphic organizers should be used and maximized inside and outside the classroom. especially in teaching science concepts in an online learning environment. Teachers should take advantage of using graphic organizers as an instructional learning material to improve student learning. Additionally, teachers should be trained in how to use various types of instructional learning materials like graphic organizers to effectively deliver science concepts.

Students' level of self-efficacy should be considered when selecting appropriate instructional learning materials for an online learning environment that will be used in teaching science subjects. In addition, teachers should design effective instructional learning materials and resources considering the level of the students' self-efficacy to facilitate learning, enhance motivation, and improve academic performance.

And lastly, the self-efficacy of the learners should be considered in designing, developing, and selecting instructional learning materials in teaching science subjects. Educational leaders and school administrators should support the use of available instructional learning materials by providing seminars and workshops to teachers and instructional developers about instructional learning material development, selection, and modification. Teachers also improve their skills in selecting and evaluating instructional learning materials by submitting themselves to training and graduate school.

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