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Design Thinking Strategy on Learners' Academic Performance in Biology

Patricia M. Trinidad [a]

Teacher I, Teodoro Evangelista Memorial High School, Baliwag City , Bulacan, Philippines[A]

A B S T R A C T

This study determined the effectiveness of Design Thinking Strategy on learners' academic performance in Biology. The study employed a quasi-experimental pretest-post-test two group design among 92 students at Teodoro Evangelista Memorial High School, Division of City of Baliwag. The statistical tools used in the study were descriptive statistics and Independent T-tests. The experimental group followed the design thinking strategy, proceeding through the framework of empathizing, defining, ideating, prototyping, and testing while the control group was taught using the traditional teaching method. Results indicated no significant difference between the pre-test scores of the control group and the experimental group. However, a significant difference was observed between the post-test scores of the control group and the experimental group. Additionally, there is a significant difference between the post-test and retention test mean scores of the learners in the experimental group wherein the teacher utilized the design thinking strategy in teaching Biology. Based on the findings of the study the following conclusions were drawn: The design thinking strategy is effective than the traditional teaching method in teaching biology. The design thinking strategy also has the ability to continuously improve learners' knowledge over time and exhibits better performance in information retention. Moreover, design thinking strategy had a positive effect on learners' experiences and developed skills relevant to the demands of the 21st century.

Keywords: *Design Thinking, Control Group, Most Essential Learning Competency*

Introduction

The foundation of knowledge is the interaction between teaching and learning. Learning is the process of absorbing and applying knowledge, whereas teaching is the art of imparting knowledge. The way that information is presented has a significant impact on how well learners absorb and remember it.

The cornerstone of effective teaching and learning are based on well-thought teaching strategies, which provide the necessary structure for exchange of knowledge and acquisition. They serve as the link between learners' receptivity and teachers' competence. These strategies cover a wide range of approaches, methods, and resources that enable teachers to motivate, engage, and inspire learners. Moreover, it is essential for ensuring that knowledge is not only conveyed but also understood, recalled, and implemented.

Especially in teaching and learning biology, biology is an essential subject that impacts our daily lives and is being studied using both deductive and inductive reasoning to increase understanding (Sayyad-Amin, 2020). In addition, out of all the science specialized courses, biology is perceived by learners as the easiest, with a 79.17% favorable assessment of the learning experience (Iqbal, 2022). However, learners still find it difficult to learn the subject, according to Joseph and Ahmad (2022) difficulties and lack of interest in studying biology are caused by four main factors: infrastructure, parents, the teacher, and the student. But biology should not be viewed as a dull or difficult subject matter; rather, it should help learners develop a global perspective (Kondaurova et al., 2020).

In science teaching, the 7E's lesson plan—characterized by its emphasis on engaging, exploring, explaining, elaborating, evaluating, extending, and enhancing—has been extensively adopted. Conceptual understanding, science process skills, and improving overall performance and academic achievement are the outcomes of the 7E learning model for science education (Jr., 2022). But, as highlighted by Marfilinda et al. (2020), this approach demonstrates moderate improvement in student learning outcomes for basic science concepts when compared to traditional teaching methods.

However, in the study of Yuliana and Taufiq (2020), which suggests that the use of 7E-based teaching materials can moderately enhance students' problem-solving abilities even though some students thought the pace of instruction was too fast. This assertion finds support in the study of Santi and Atun (2021) that it needs sufficient time management and thoughtful planning at each stage of the learning cycle 7E model to be effective, particularly in teaching acid-base principles.

Because of these disparities, the 2022 Program for International Student Assessment (PISA) results reveal that, out of 81 participating countries, the Philippines ranked lowest in reading and third to last in science (OECD, PISA 2022). Similar to this, the Philippines' performance in science and mathematics ranked last among the 58 countries participating in the 2019 Trends in International Mathematics and Science Assessment (TIMSS) (Mullis et al., 2020). These alarming findings highlight the dire need for curriculum review, innovative methods of instruction, and all-encompassing initiatives to improve student performance. The above measures are necessary to bridge the academic gaps on the international stage and better equip learners for the challenges of the twenty-first century.

In the locality, exit assessment results from the Schools Division of Bulacan showed that learners in grades 7 to 10 did not achieve the standard minimum proficiency level. Notably, one of the lowest levels of proficiency that learners failed to achieve was in science competencies. It is also highlighted that among these grades, science received the lowest proficiency levels in Grade 10 (Schools Division of Bulacan, 2022).

Teodoro Evangelista Memorial High School data further supports this observation, showing that learners in Grades 7 through 10 have not been able to meet competency requirements in science. This illustrates the significant challenge Teodoro Evangelista Memorial High School students face in mastering science subject. To address and improve students' overall science competency levels, it is clear that focused interventions and a thorough approach to science education must be adopted.

With such competency-based assessments, internationally and locally, it emphasizes the need for comprehensive measures to address the issue of poor academic performance and the student's perception in the subject. As per the findings of Rogayan Jr. (2019), "low performance in the subject is due to inappropriate learning plan and teaching strategy used by teachers." This observation underscores how important pedagogy and instructional design are in shaping learners' progress and emphasizes how important it is to align teaching strategies with learners' needs and learning preferences in order to support better learning outcomes.

There are several studies that have a chance to change the way science has traditionally been taught, one of which is the design thinking process. Design thinking has gained widespread acceptance as an innovation technique during the past few decades (Mosely and Tomitsch, 2018). In order to promote creativity and advance critical thinking skills, design thinking approaches and practices have been included into secondary and post-secondary education curriculum (Aflatoony et al., 2018).

The challenges in education prompted the researcher to delve into the concept of design thinking as an innovative teaching strategy in the science classroom and aimed to explore its effectiveness in the academic performance of the learners through its implementation. The insights gleaned from this will provide the foundation to craft a tailored lesson plan that aims to enrich learners' educational experiences by providing them with a more interesting and practical method of learning. With this, teachers will therefore be more equipped to provide education that is effective and gives learners the skills they need to succeed in the twenty-first century.

Conceptual Framework

Figure 1

The Paradigm of the Study

Independent Variable Dependent Variable

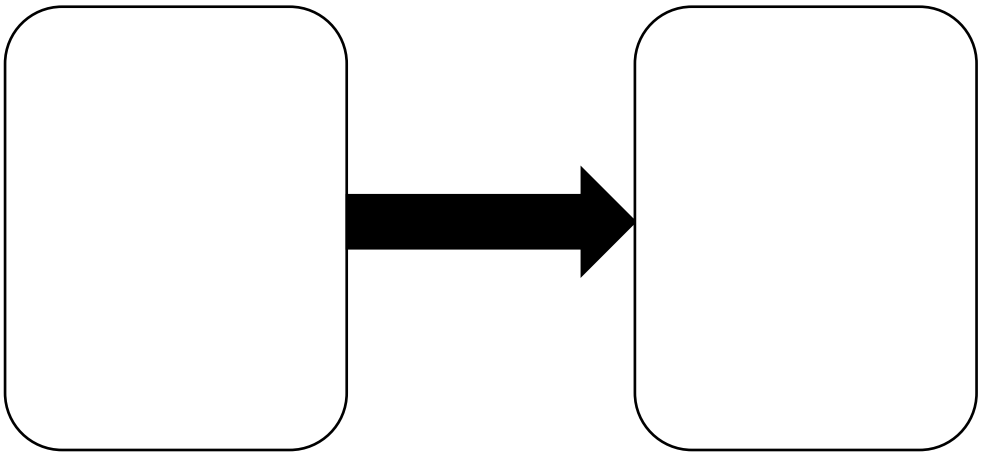

Figure 1 shows the independent variable, Design Thinking (DT) Strategy and the learners' academic performance as dependent variable. An arrow shows the direction of influence, indicating that Design Thinking (DT) Strategy has a possible impact on learners' academic performance in biology. The learners' academic performance may vary based on the result of the implementation.

Statement of the Problem

This study aimed to determine the effectiveness of Design Thinking Strategy in teaching Biology to Grade 10 learners in Teodoro Evangelista Memorial High School for School Year 2023-2024.

Specifically, the study sought to answer the following questions:

1. How may the pre-test results of the control group and experimental group be described?

2. How may the post-test results of the control group and experimental group be described?
3. How may the retention test result of the experimental group be described?
4. Is there a significant difference between the pre-test results of the control group and the experimental group?
5. Is there a significant difference between the post-test results of the control group and the experimental group?
6. Is there a significant difference between the post-test and retention test results of the experimental group?
7. What are the learners' views and insights on the use of the design thinking strategy in science?

Hypotheses

The incorporation of design thinking into the classroom and subsequent testing of its effectiveness were guided by the following hypotheses:

1. There is no significant difference between the pretest results of the control group and experimental group.
2. There is no significant difference between the posttest results of the control group and experimental group.
3. There is no significant difference between the posttest and retention test results of the experimental group.

METHODOLOGY

Research Design

The research employed a quasi-experimental design, which includes pre-test and post-test two group designs to assess the effectiveness of design thinking strategy in teaching Biology. To address practical and ethical concerns, pre-existing groups was chosen rather than randomly assigned in this quasi-experimental design. The research is divided into two distinct stages: a pre-test to determine both groups' baseline knowledge and abilities, and a post-test to assess results following the application of the design thinking strategy. A comparative investigation of the strategy's impact is made possible by the employment of two groups: an experimental group and a control group. The assessment, which places a strong emphasis on practical application, takes place in a classroom setting and offers insights into how well the approach functions.

In conclusion, the study aimed to determine how the design thinking strategy affects biology students learning outcomes by examining the statistical significance of differences noticed between the experimental and control groups.

Sampling and Respondents

The participants of this study comprised 92 Grade 10 learners enrolled in the School Year 2023-2024. The selection of participants followed a total enumeration sampling, wherein the researcher chose the two sections from Grade 10 level. Subsequently, one of these sections was randomly assigned as the experimental group, which were exposed to the design thinking strategy, while the other section served as the control group and did not receive any treatment. Grade 10 learners were chosen as participants because the researcher had direct access to both groups. To maintain objectivity and minimize biases, participants were provided with an orientation on the process of design thinking.

Table 1

Respondents of the Study

Grade Level and Section	Total
Grade 10 Sampaguita	46
Grade 10 Rose	46

To gather qualitative data, 10 learners from Grade 10-Sampaguita were randomly selected. These learners had been exposed to the design thinking strategy, and they were asked to provide their views and insights on the design thinking strategy.

Locale of the Study

This study was conducted at Teodoro Evangelista Memorial High School, a Public High School in Baliwag South District, City of Baliwag, Bulacan, as the research setting is underpinned by a significant percentage of learners exhibiting a low level of proficiency in science, as indicated in the Learning Continuity Plan, Schools Division of Bulacan, 2021-2022. This study aims to substantially enhance the science academic performance of learners in Teodoro Evangelista Memorial High School.

Instruments

The instrument used was a researcher-made test based on Most Essential Learning Competencies (MELCs) with a table of specification. The questionnaires were organized according to the female and male reproductive systems, feedback mechanisms involved in regulating processes in the female reproductive system, and the nervous system. Pre-test and Post-test were administered to both the experimental and control groups. The test consisted of 50 multiple-choice items designed to measure the learners' academic performance in Biology. Ten days after the post-test, a retention test was given to the experimental group to assess how much of the information had been recalled after the treatment. The retention test was identical to the post-test that the respondents completed after a 10-day gap. The validity of the test questionnaire, along with the table of specifications and lesson plans, was validated by three master teachers in science.

Data Gathering Procedure

Before the collection of data, the researcher sought permission from the School Principal of Teodoro Evangelista Memorial High School and the Schools Division Superintendent of Bulacan in order to conduct the study in Baliwag South District, City of Baliwag, Bulacan.

In accordance with Regional Memo No. 228, s. 2020, the researcher adheres with the policy guidelines on ethical research principles and responsibilities by ensuring confidentiality in handling data of respondents and providing consent forms. Therefore, informed consent and assent form was obtained from the participants before the conduct of the study. The researcher oriented and informed the respondents about the research's goal, duration, potential risks, and benefits. The collected data were treated confidentially, stored securely in a protected folder accessible only to the researcher, and retained according to policy guidelines. Furthermore, the study shall strictly follow the directives provided in Memorandum No. 9, s. 2022, with regard to data collection, data protection, data transport, storage, and destruction protocols. The teaching of the lessons under the control group was conducted through the conventional approach. In contrast, the experimental group were exposed to a five-stage Design Thinking process, which includes the following steps: The empathy level, introduction of the topic by discussing real-world issues. At the defining stage, learners were in a group to identify the main issue and collaborate with one another. The ideate stage, learners generated ideas for potential solutions. Prototype, learners collaborated, submitted solutions, received feedback, and revised. Lastly, in the testing stage, each group presented and evaluated its solutions, emphasizing constructive criticism and reflection.

The entire process lasted over a span of 3 weeks during the third quarter grading period. After the treatment, a post-test was administered to both groups, with a second assessment after a 10-day interval to assess lasting impact. The results of the study underwent statistical analysis as part of the research process.

Subsequently, interviews with randomly chosen grade 10 learners were conducted to get their insights regarding the strategy. The results of the study were further validated and supported by the collected interview data.

Data Analysis

In determining the effectiveness of the Design Thinking Strategy in Biology to Grade 10 learners, pre-test and post-test were administered before and after the treatment to both the control group, which were not exposed to the strategy, and the experimental group, which was exposed to the strategy. Additionally, a retention test was administered after 10 days to assess whether there are differences in the scores of the two groups. The following statistical tools used to compute the results:

Descriptive statistics were utilized to determine the academic performance of experimental and control groups in the pre-test, post-test, and retention test.

Independent T-tests were used to determine if there is a significant difference between the pre-test, post-test scores and retention test scores of both groups.

Ethical Consideration

The participants of the study were provided detailed information about the research before they were allowed to participate. Those who chose to participate were given a consent and assent form adhering to the provisions outlined in the Data Privacy Act of 2012, ensuring the confidentiality of participants' identities and privacy.

Additionally, the study strictly followed the recommended procedures of Memorandum No. 9, s. 2022 for data collection, security of collected data, storage, transfer, and destruction procedures. The participants' identities and other identifying information were not disclosed without their explicit consent. Proper citation and credit were given to the authors mentioned in the study.

The researcher upheld the integrity of the data avoiding data fabrication and data falsification, as outlined in the ethical practices. The actual benefit of the study, meeting the needs of the respondents, and encouraging positive change in the classroom will be prioritized.

Furthermore, the researcher ensured that after the specific purpose for which the data were gathered and used, the data were no longer retained and were subjected to disposal. The data were destroyed in a manner that leaves no possibility for the recovery of information, using methods such as shredding and cross-shredding.

RESULTS AND DISCUSSIONS

This chapter presents the data collected and discussions, revealing how the Design Thinking Strategy was implemented in comparison to traditional methods of teaching.

Pre-Test Results of the Control Group and Experimental Group

The pre-test is an assessment that learners take to determine their baseline knowledge of the lesson, specifically in Biology. The assessment was conducted on both the experimental and control groups, and the outcomes are shown in Table 2.

Table 2

Results of the Pretest between the control and experimental groups

	Control Group		Experimental Group	
Range	**Frequency**	**Percentage**	**Frequency**	**Percentage**
41 – 50	0	0.00	0	0.00
31 – 40	0	0.00	0	0.00
21 – 30	4	8.70	14	30.43
11 – 20	31	67.39	28	60.87
0 – 10	11	23.91	4	8.70
Standard Deviation	**4.32**		**4.65**	
Mean	**13.98**		**17.13**	
Verbal Interpretation	**Fair**		**Fair**	

Legend: 0-10 "Poor", 11-20 "Fair", 21-30 "Good", 31-40 "Very Good", 41-50 "Excellent"

Table 2 shows the pretest findings for the control group, which had an average score of 13.98 with a verbal interpretation of "fair," whereas the experimental group had an average score of 17.13 with a verbal interpretation of "fair". It was noticed in the table that the scores of the students in the control group were a bit closer to one another (sd = 4.32) rather than the scores in the experimental group (sd = 4.65). Furthermore, the greatest and lowest pretest scores recorded by the control group were 26 and 5, respectively. On the other hand, the highest and lowest scores in the experimental group were 26 and 7, respectively.

Furthermore, the pretest results of the control group revealed that only 4 out of 46 students (8.70%) received a score between 21 and 30, whereas 11 out of 46 students (23.91%) had a score between 0 and 10. Also, the pretest scores of the experimental group revealed that 14 out of 46 students, or 30.43%, received a score between 21 and 30, whereas only 4 out of 46 students, or 8.70%, received a score between 0 and 10.

The result indicates that the baseline knowledge of both the control and experimental group was fair. This means that both groups are at the 'fair' level before the intervention. This might be the result of the learners' lack of prior knowledge regarding the questions and the unfamiliarity of the test's contents. According to Riesen et al., (2018), students with low-intermediate prior knowledge benefit more from experiment design guidance in science inquiry learning, suggesting that prior knowledge is needed for optimal learning outcomes. This is also supported by the study of Witherby and Carpenter (2021) that in specific subject areas, learning is positively impacted by prior information, and curiosity plays a part in influencing this interaction between existing knowledge and new learning (Wade and Kidd, 2019). It implies that curiosity can improve how well past information is applied to new learning experiences.

Post-Test Results of the Control Group and Experimental Group

After the treatment, both groups undergone the same test but in shuffled and paraphrased format and exhibited a different result, as indicated in Table 3.

Table 3

Results of the Posttest scores of Experimental Group

	Control Group		Experimental Group	
Range	**Frequency**	**Percentage**	**Frequency**	**Percentage**
41 – 50	0	0.00	0	0.00
31 – 40	9	19.57	6	13.04
21 – 30	14	30.43	30	65.22
11 – 20	22	47.83	10	21.74
0 - 10	1	2.17	0	0.00
Standard Deviation	**7.80**		**5.80**	

Mean	**21.07**	**25.24**
Verbal Interpretation	**Good**	**Good**

Legend: 0-10 "Poor", 11-20 "Fair", 21-30 "Good", 31-40 "Very Good", 41-50 "Excellent"

Table 3 illustrates that the control group's posttest scores averaged 21.07 with a verbal interpretation of "Good," whereas the experimental group's posttest scores averaged 25.24 with a verbal interpretation of "Good" as well. The table shows that the students' scores in the experimental group are substantially closer together (sd = 5.80) than the scores in the control group (sd = 7.80). Furthermore, the highest and lowest posttest scores observed in the control group were 10 and 35, respectively. Meanwhile, the highest and lowest posttest scores in the experimental group were 39 and 12, respectively. Likewise, the pretest results for the control group revealed that just one out of 46 students (2.17%) obtained a score between 0 and 10, whereas nine out of 46 students (19.57%) received a score between 31 and 40. Also, the experimental group's posttest scores revealed that only 0 out of 46 students (0%) had a score between 0 and 10, however 6 out of 46 students (13.04%) obtained a score between 31 and 40.

This implies that the new strategy used in experimental group, Design Thinking, is effective in teaching biology lessons than the use of the traditional teaching method.

In addition, the result conforms with the study of Ramos and Inocian (2022), that the average post-test scores for both groups were deemed "good," although the experimental group outperformed the control group in terms of mean. This illustrates how the two groups performed differently even if their descriptions were comparable.

Retention Test Result of the Experimental Group

A retention test was administered to the experimental group to assess how much of the information has been recalled after the treatment. The retention test was the same as the post-test and it is conducted after a 10-day gap.

Table 4

Result of the Retention test scores of the Experimental Group

	Experimental Group	
Range	**Frequency**	**Percentage**
41 – 50	0	0.00
31 – 40	10	21.74
21 – 30	25	54.34
11 – 20	11	23.91
0 - 10	0	0.00
Standard Deviation	**5.65**	
Mean	**25.83**	
Verbal Interpretation	**Good**	

Legend: 0-10 "Poor", 11-20 "Fair", 21-30 "Good", 31-40 "Very Good", 41-50 "Excellent"

As demonstrated by Table 4, the experimental group's average retention test result was 25.83, with a verbal interpretation of "Good". The chart also showed that the standard deviation of the students' results was high (sd = 5.65), indicating that the scores were spread out. And the greatest and lowest scores were 37 and 13, respectively.

The results imply that on average the experimental group performed well on the retention test. This means that the Design Thinking Strategy had an impact on the learner's performance, its effects persisted over time rather than being temporarily. This shows that the learners benefited from the learning experiences they acquired during the treatment. This is supported by the study of Weller and Cross (2018), that the key design elements that affect student retention include integrated, collaborative, engaging, balanced, practical, reflective, and gradual. These elements make sure that learning experiences are integrated, require teamwork, attract attention, provide a balanced approach to content delivery, make effective use of resources, foster critical thinking, and permit gradual learning and mastery.

All these factors are coinciding in the Design Thinking Strategy framework that incorporating individual experiences and feedback, thinking critically, using creativity, as well as communication skills are all necessary for effective problem-solving (Ray, 2020).

Difference Between Control and Experimental Groups Pretest scores

Table 5

Test of Significant Difference on Pretest scores between the Control and Experimental Groups

	Mean	t-value	p-Value	Decision	Interpretation
Control Group	13.93	-3.18	0.40	Do not reject H_o	There is no significant difference
Experimental Group	17.13				

Legend: < 0.01 = sig

Table 5 displays the test of significant difference on pretest scores between the control and experimental groups. Since the p-value is 0.40 which is greater than at 0.01 level of significance, therefore, we do not reject the null hypothesis. Moreover, it indicates that there is no significant difference between the pretest scores of both groups of respondents.

This implies that the pretest scores of both groups seem to exhibit no significant variance. This means that both groups' baseline levels were comparable prior to the application of any intervention, such as the introduction of a new teaching strategy. This result is essential for ensuring the validity of any further comparisons between the groups that are conducted once the intervention has been implemented.

Similarly, in the findings of Udeani and Okekwuo (2023) study, it was revealed that the mean pretest scores of both the experimental and control groups were closer. This conforms that both groups started at a similar level before any intervention or treatment was administered.

Learners' Performance in the Pre-test and Post-test

Table 6

Test of Significant Difference on Change in Post-test scores and Pretest scores between the Control and Experimental Groups

	Mean	t-value	p-Value	Decision	Interpretation
Control Group	21.07	3.79	0.00	Reject H_o	There is a significant difference
Experimental Group	25.91				

Legend: < 0.01 = sig

As shown in table 6, the test of significant difference in change in posttest and pretest scores between the control and experimental groups reject the null hypothesis because the p-value of 0.00 is less than 0.01 level of significance.

Given the results of the tests conducted before and after the intervention, it appears that there was a significant difference in learners' academic performance in the experimental group. This implies that the intervention had a positive effect on the experimental group's performance than the control group.

In addition, the participatory and engaging nature of the design thinking instructional strategy likely contributes significantly to the observed difference in outcomes. By encouraging active participation, teamwork, and problem-solving, learners in the experimental group have gained a deeper understanding of the biology lessons.

The findings of this study were aligned with the study conducted by Ramos and Inocian (2022), learners' academic achievement was significantly improved by the application of the design thinking strategy. This suggests that as compared to students who were taught using traditional teaching method, students who were taught using the design thinking strategy did better academically. In essence, it suggests that when compared to traditional teaching methods, the design thinking strategy is effective in improving students' academic performance

Difference of Post-test and Retention Test of the Experimental Group

Table 7

Test of Significant Difference between Posttest and Retention Test of the Experimental Group

	Mean	t-value	p-Value	Decision	Interpretation
Posttest	25.91	3.27	0.00	Reject H_o	There is a significant difference
Retention Test	27.98				

Legend: < 0.01 = sig

Table 7 illustrates the test of significant difference between the posttest and retention test of the experimental group with a p-value of 0.00 which is less than the significance level at 0.01 therefore, reject the null hypothesis.

It implies in the study that using the Design Thinking Strategy in the experimental group is an effective teaching strategy to enhance students' retention knowledge about the subject matter. This is explained in the study of Hassan (2023), that the reason why design thinking helped learners retain the information for extended periods of time because Design Thinking encouraged students to think like designers and look for unconventional solutions, emphasizing the relevance of the problems to their daily lives.

Based on the findings, it validates the experimental group's collaboration, creativity, critical thinking, and communication throughout the treatment. They are all sharing ideas on the problem or issue they are trying to address and working on the feedback that every group needs for them to have a complete understanding of the problem and provide effective solutions. Therefore, Design Thinking Strategy really helps learners to retain more information (Albay and Eisma, 2021).

Learners' views and insights on the use of the Design Thinking Strategy

The learners under the experimental group who participated in the interview to share their views and insights on the use of the design thinking strategy were randomly selected and interviewed after completing the treatment. Based on the interview of Learner 1 she said, *"this strategy is not easy at first but later on you will find it fun because of sharing your ideas with your groupmates and presenting it also with them and after presenting it, other groups will criticize your work but in a good way because it will help your groups to improve something".* Therefore, it was challenging for learners to initially adapt to a new teaching strategy. Hence, it might take some time for learners to become used to new approaches as they learn the lesson. This insight was also supported by Learner 3 that *"design thinking is a better way of teaching because this method teaching is more understandable, and you are not alone. On my experience it's kind of hard at first but you will get used to it and you will realize that it is better"*. Moreover, Learner 2 also added *"sa pagkakaroon ng malawak na kaisipan at marami din akong natutunan nung una ay nakakapanibago pero nung tumagal naiintindihan ko na."* Therefore, the same sentiments of the learners about their insights in using design thinking strategy that the learners are urged to come up with relevant ideas and to think creatively beyond the box. Design Thinking places a strong emphasis on a human-centered approach to education, making each person's wants and experiences the core of the learning process (Van Gompel, 2019).

With this, they also share some of their experiences during the treatment and Learner 4 said *"bukod sa reporting at pagtayo sa harap ay igrupo kami ng aming teacher and sa grupo na yan kailangan may brainstorming. Mahalaga ang brainstorming sa grupo upang makatulong sa gagawin na reporting doon ay nag sshare kami sa isa't isa ng mga natutunan sa topic para may maganda at maayos na maipresent and after reporting, we need to criticize our group works to improve and because of that you gradually develop the courage to deal with many people you will also use to socializing with other people."* As well as in the interview with Learner 7 that *"sa pamamagitan ng pagtutulungan mas marami information na maaaring pagsama samahin para makabuo tayo ng idea at para makita din ang kakalabasan o magiging outcome nito. Makakatulong din ito para makita ninyo kung ano ang dapat improve o baguhin."*

This only shows that collaboration has an impact on utilizing the design thinking strategy and it only proves that in order to create activities that addressed issues related to society, learners in the experimental group were given the chance to work with groups (Ramos and Inocian, 2022). It is also highlighted by Learner 5 that *"working in groups and sharing ideas is important kapag po ginagawa ang design thinking strategy. Kasi ito yung way para mas maayos na reporting and to expand what we learned in the lesson."* And aligned with the answer of Learner 6 that *"it is helpful in solving science problems and much helpful when using in group."* Furthermore, it is also said by Learner 9 *"sa pamamagitan ng teamwork at pag sshare ng ideas ay mapapadali ang inyong gawain, maimprove mo yung pagiging mahiyain at mas marami ka matututunan at malalaman."*

Likewise, in the study of Ramos and Inocian (2022), findings revealed that the participants' critical thinking, teamwork, communication, and creativity were all significantly improved when Design Thinking was included in the classroom. This is aligned with the views of Learner 8 that *"group work can help communication skills, teamwork and a sense of collective ownership over the project that can lead to a more successful outcome."* For that reason, Learner 10 also expressed his view that *"beneficial ang strategy na ito patungkol sa scientific concepts dahil matutulungan ka nito na mas mapadali ang iyong pagkakaintindi sa lessons. And another thing naging beneficial ito para saakin dahil your self confidence and self-esteem gradually build."*

In conclusion, the application of Design Thinking Strategy to biology highlights its efficacy as a human-centered approach in education. By means of collaborative efforts targeted at tackling societal issues, students in the experimental group have exhibited significant progress in cooperation, communication, teamwork, and confidence in oneself.

This qualitative data, gathered from interviews indicates that design thinking strategy not only enhances academic performance but also fosters the development of essential skills needed for the 21st century. This supported the idea that one of the teaching strategies that might improve students' development for the 21st century skills is Design Thinking as mentioned in the study of Ramos and Inocian (2022)

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Findings

The study determined the effectiveness of Design Thinking Strategy in teaching Biology to Grade 10 learners and ascertained learners' views and insights on the use of the design thinking strategy.

Based on the results and discussion in the preceding chapter, the answers to the problems raised in the study were discovered and summarized as follows: Findings revealed that before the exposure of Grade 10 learners to traditional teaching method and new teaching method their baseline knowledge in Biology was both considerably fair.

After exposing them to traditional teaching and design thinking strategy both of their performances in the post-test were both described as good. However, in terms of its mean scores, the experimental group performed better than the control group.

Consequently, the experimental group had their retention test which is the same post-test after a 10-day gap. The findings revealed that the learners from the experimental group not only retained the knowledge learned during the intervention but also showed improvement over time.

It was also found that there is no significant difference between the pretest scores of control and experimental group. Findings revealed that both groups' baseline levels were comparable prior to the application of the new teaching strategy.

Moreover, it was found that there is a significant difference between the post-test mean scores of the control group and experimental group. This suggests that Design Thinking was effective in teaching biology lessons than the use of the traditional teaching method.

Additionally, there is a significant difference between the post-test and retention test mean scores of the learners in the experimental group wherein the teacher utilized the design thinking strategy in teaching Biology. Therefore, the new teaching strategy is effective in retaining information in learning biology.

Furthermore, interviews revealed that when the Design Thinking Strategy was introduced in biology class, learners at first felt intimidated because of the new process. But as they eventually became familiar with this new strategy, they discovered that it was better than the traditional teaching method. Interestingly, they stated that using Design Thinking led to improvements in a variety of skills, such as confidence, creativity, critical thinking, and teamwork. This shows that despite the initial challenge they encountered, learners understand the advantages of the Design Thinking Strategy and its significance in promoting their overall development.

Conclusion

Based on the findings of the study, the Design Thinking Strategy is effective than the traditional teaching method in teaching biology. It has the ability to improve learners' knowledge over time and exhibits better performance in information retention. Furthermore, the strategy promotes students' experiences and develops abilities relevant to 21st-century needs.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are hereby offered:

1. The school may conduct training for teachers during LAC sessions on the design thinking process and guide them in creating lesson plans that are efficient and tailored to the student's needs.
2. Encourage teachers to incorporate the elements of design thinking strategy to promote deep understanding and retention of concepts beyond the classroom setting.
3. Further studies on the use of design thinking strategy in teaching biology, particularly with a larger population.
4. Other researchers may utilize the effectiveness of design thinking strategy in teaching other subjects to other grade levels.

LITERATURE CITED

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