



ACTIVATING STRATEGIES IN TEACHING PHYSICAL SCIENCE: DIRECTION TOWARDS ENHANCED STUDENTS' CRITICAL THINKING SKILLS

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ABSTRACT

Teaching Science is challenging; teachers find it exciting. To sustain eagerness and attention of the students, teachers need to learn the subject and choose strategies which can help enhance students' skills. With that, the study aimed to ascertain the effectiveness of activating strategies in teaching Physical Science toward enhanced students' critical thinking skills in St. Thomas Academy. The study utilized experimental design involving the participation of 105 Grade 11 match paired students. It used diagnostic test to assess the students' prior knowledge, survey questionnaire to evaluate their needs, interest, and attitude towards Science subject before the implementation of the activating strategies such as carousel brainstorming, challenge envelopes, and talking drawings. It also used learning plans in each activating strategy during the lesson. Pre-test and posttest were administered to assess their critical thinking skills. Students' preparedness in terms of prior knowledge, needs, interest, and attitude towards Science subject were analyzed and interpreted using standard deviation and mean, frequency, mean difference, t-test was used to test the difference on the transmuted mean gain scores of the respondents. Pearson r, multiple comparisons to compare the results of the scores in each strategy per subskill, and ANOVA to analyze the relationship among the variables under students' preparedness and critical thinking subskills. Furthermore, the study found out that there is a significant difference in the pre-test and post-test scores of the three groups exposed to the different activating strategies as to their critical thinking skills. Lastly, there is a significant difference in the mean post-test scores of the groups exposed to the different activating strategies as to their critical thinking skills and there is a significant relationship between student preparedness and critical thinking skills

Keywords: Activating Strategies, Critical Thinking Skills, Carousel Brainstorming, Talking Drawings, Challenge Envelopes, Philippines

INTRODUCTION

Science, like any other learning area in the K to 12 curricula, is operative only if students can apply in their life situations the concepts learned in the class. Teacher plays a very crucial role in the learning process. Strategies and approaches in teaching has a huge part in the success of learning. Today's learners must be actively involved in the teaching and learning process. Different activities must be utilized to develop

their critical thinking skills. Students should be motivated to do their learning tasks independently to ensure that better retention takes place. Teachers need to empower the learners to think critically and creatively.

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Teachers need to empower the learners to think critically and creatively.

According to the Department of Education Regional Memorandum No. 11 s. 2015, Teaching and Learning Approaches Across Learning Areas that Support Teacher Practice, there are five major approaches: Constructivist, Collaborative, Integrative, Reflective and Inquiry Based Learning (2C-21-1R) which the Department of Education follows. These approaches contain five core strategies and with these strategies, it is hoped that teachers can now improve learners understanding of the learning outcomes, heighten learner's ability to read, write and reason, and ultimately meet the K12 curriculum standards that can also enhance students' skills.

Learning without broader understanding creates misconception and makes application of the knowledge gained to the future difficult. Learning is always believed to be the final product of teaching; it is not always certain that learning really takes place. Hence, enough knowledge of the teachers on how learning takes place will influence them to contemplate how they teach, educate, and how their students acquire the lessons (Andas, 2014).

Hence, this study gave emphasis particularly in the activating strategies that may enhance the critical thinking skills of the grade 11 students. Its focal point is to help teachers gain ideas on how to improve and enhance their strategies in teaching Science to the students that will steer to a new, positive, and successful learning.

In view of this, teacher must determine strategies that would suit the interests, needs, and abilities of the learners. The researchers believe that using activating strategies in teaching Physical Science would enhance the critical thinking skills of the students.

OBJECTIVES OF THE STUDY

This study was conducted to: 1) determine students' preparedness in terms of their prior knowledge, needs, interests, and attitude towards science subject; 2) determine the mean pre/post test scores of the groups exposed to the activating strategies as their critical thinking

skills; 3) test the difference in the pre-test and post-test scores of the three groups exposed to the different activating strategies as to their critical thinking skills; 4) test the difference in the mean post-test scores of the groups exposed to their critical thinking skills and; 5) determine the significant relationship between student preparedness and critical thinking skills as to verbal reasoning, argument analysis, and decision making.

MATERIALS AND METHODS

The study utilized the experimental method of research and involved 105 Grade 11 students from St. Thomas Academy from the 3 academic track sections. The respondents were match paired using their pre-test scores. Most of them were of the same age, gender, and mental ability to ensure the validity of the research study.

The study undertook the following process: Phase I was the preparation and validation of survey questionnaire, tests and criteria. Phase II was the designing of learning plans. Phase III was the permission to conduct the study from the office of the administration of St. Thomas Academy, Sto. Tomas, Batangas. Phase IV was the distribution of the survey questionnaires and administration of the diagnostic test and pre-test. Phase V was the execution of the learning plans with different activating strategies. Phase VI was the administration of post-test.

Furthermore, the data collected was subjected to the following statistical treatment and was analyzed. The pre-test and post-test scores of the students who were exposed to Activating Strategies, frequency, standard deviation, and mean were utilized.

In the test of difference in the pre-test and post-test results of the three groups in critical thinking skills when taught using the different activating strategies, multi-factor ANOVA was used.

To model the relationship between the moderating variables and dependent variables, Pearson r was used.

RESULTS AND DISCUSSIONS

1. Students' Preparedness

The succeeding tables present the data gathered from the conduct of the diagnostic test and survey questionnaire to identify the preparedness of the students in terms of prior knowledge, needs in learning science, interest, and attitude towards science.

1.1 in terms of Prior Knowledge

Table 1
Students' Preparedness in terms Prior Knowledge in Physical Science

Groups	SD	Mean	V.I.
Carousel Brainstorming	4.86	82.63	AP
Challenge Envelopes	4.55	83.97	AP
Talking Drawings	4.88	84.09	AP
Overall	4.76	83.56	AP

The groups are in the approaching proficiency level and have the same level of preparedness in terms of prior knowledge. This may imply that the students' preparedness in terms of prior knowledge are in the mid-level which may suggest that they know something about the selected topics in their physical science subject and they are ready to activate their prior knowledge that will bridge to a new and accountable learning. Students are now prepared to face a new challenge in learning their science subject.

1.2 Needs in Learning Physical Science

In the carousel group, it is very true that students need to decide whether to accept or reject their hypothesis based from the experiment they performed, learn more on scientific ideas and discoveries, perform and analyze more experiments to understand the lessons easily, and reason out their ideas about the lesson for suggestions and clarification purposes which are interpreted as Highly Prepared, the findings suggest that students are ready to face those needs in learning Science and it may be of help in identifying those for easier learning. However,

for the challenge envelopes group, they just perceived the indicator learn more on scientific ideas and discoveries as true of them and is verbally interpreted as Prepared.

In totality, based on the data, all the groups are prepared. These imply that the groups have some similarities on their needs in learning the subject and it may infer that teachers should consider these for a better and guided teaching-and-learning process. Identifying the needs of every student would give assistance for both learners and teacher to come up with a better learning environment.

1.3 Interest in Learning Physical Science

It can be depicted that all the groups found physical science as highly interested which is verbally interpreted as Highly Prepared. However, the carousel brainstorming group found out the indicators, physical science is enjoyable because of their teacher and they like doing activities and answering laboratory sheets as interested and interpreted as Prepared.

In full amount, based on the data, all the groups are prepared. This may advise that they are really prepared since they are highly interested in learning physical science. The results assert the willingness of the students to learn more and listen attentively to the lesson. Therefore, this denotes that teachers may make the subject more interesting by doing and executing the indicators presented. Making extra effort in the part of the teacher can make the learners more eager to acquire new learning.

1.4 Attitude in Learning Physical Science

It can be inferred that all the groups perceived Science with high positive attitude which is verbally interpreted as Highly Prepared. However, the carousel brainstorming group observed the indicator, Science is delightful and inspiring with positive attitude and interpreted as Prepared.

In view of this, based on the data, all the groups are prepared. This may advise that they are really prepared since they have high positive



attitude towards Physical Science. This suggests that the learners are open to a new learning which can make them love and learn the subject more. This implies that teachers may consider the attitude or behavior of their students in the subject

for it may affect how they learn and think. Knowing this can help the teacher to adjust and identify the things that can encourage and motivate one's participation.

2. Pre-test and Post test scores of the groups exposed to the activating strategies in terms of critical thinking skills

The following tables present the data gathered from the conduct of the pre-test and posttest using activating strategies in enhancing

the critical thinking skills in terms of verbal reasoning, argument analysis, and decision-making subskills.

2.1 Pre-test Scores of the groups in terms of Critical Thinking Skills

Table 2
Mean pre-test scores of the groups in terms of Critical Thinking Skills

Critical Thinking Skills	Activating Strategies								
	Carousel Brainstorming			Challenge Envelopes			Talking Drawings		
	SD	Mean	VI	SD	Mean	VI	SD	Mean	VI
Verbal Reasoning	2.87	74.11	B	1.93	74.23	B	2.98	74.17	B
Argument Analysis	3.93	67.86	B	2.43	68.66	B	2.88	68.57	B
Decision Making	3.48	71.57	B	4.71	72.54	B	2.02	72.63	B
Overall	3.43	71.18	B	3.02	71.81	B	2.63	71.79	B

Table 2 demonstrates the mean pre-test scores of the respondents of the three groups in terms of their critical thinking skills. It can be perceived based on the scores that the three groups have similar measures of mastery level in critical thinking skills respectively. In addition, it can be shown that learners' existing knowledge in terms of their critical thinking skills are low and described as Beginning. Students do not have enough prior knowledge regarding the topic, and

they must be guided and taught meaningfully with the aid of the different activating strategies. Using those may be of help to them to enhance their critical thinking skills which can lead to their higher performance. They got the lowest pre-test scores in the argument analysis subskill since they did not have enough knowledge about these particular on the proofs and evidences. Having adequate testimonies and confirmations needs them and must be enhanced.

2.2 Post test scores of the Groups in terms of Critical Thinking Skills

Table 3
Mean post test scores of the groups exposed to activating strategies in terms of Critical Thinking Skills

Critical Thinking Skills	Activating Strategies								
	Carousel Brainstorming			Challenge Envelopes			Talking Drawings		
	SD	Mean	V.I.	SD	Mean	V.I.	SD	Mean	V.I.
Verbal Reasoning	4.30	78.97	D	5.07	80.77	AP	5.72	82.43	AP
Argument Analysis	4.82	73.40	B	6.54	79.83	D	5.55	77.86	D
Decision Making	6.15	79.74	D	6.62	82.29	AP	5.40	81.97	AP
Overall	5.09	77.37	D	6.08	80.96	AP	5.56	80.75	AP

It can be shown in Table 3 the mean post test scores of the respondents of the three groups in terms of their critical thinking skills such as verbal reasoning, argument analysis, and decision making. The posttest was given to the three groups exposed to the different activating strategies in selected topics in their Physical Science subject. The numerical results suggest that the group under challenge envelopes elevated the performance in the decision making more than the verbal reasoning and argument analysis subskills. It can be also shown that the group under talking drawings acquired higher performance in their verbal reasoning more than decision making and argument analysis. The group under carousel brainstorming got higher performance in the decision-making skill more than verbal

reasoning and argument analysis. As per subskill, the groups got the lowest mean posttest scores in their argument analysis subskill. This may imply that their thorough knowledge on that topics are not that enhance and has to be developed for better understanding and learning.

Generally, the three groups—engaged with different activating strategies have an entire mark as Developing (D) for the carousel brainstorming group on their mastery level for the group exposed to challenge envelopes and for talking drawings. Therefore, all of the three activating strategies are good to implement as essences in teaching-learning process. However, it can be noted that challenge envelopes strategy enhances the critical thinking skills of the learners and thus it may be an effective way in facilitating class interaction.

3. Difference of pre-test and post-test scores of the three groups exposed to the different activating strategies in terms of critical thinking skills

Table 4

Difference of pre-test and post-test scores of the groups exposed to different activating strategies in terms of critical thinking skills

Critical Thinking Skills	Carousel Brainstorming				Challenge Envelopes				Talking Drawings			
	MD	SD	t-value	p-value	MD	SD	t-value	p-value	MD	SD	t-value	p-value
Verbal Reasoning	-4.86	4.04	-7.104	.000	-6.54	4.58	-8.46	.000	-8.26	5.67	-8.62	.000
Argument Analysis	-5.54	4.62	-7.093	.000	-11.17	6.19	-10.68	.000	-9.29	5.69	-9.65	.000
Decision Making	-8.17	5.33	-9.258	.000	-9.74	6.16	-9.36	.000	-9.34	5.04	-10.97	.000
Overall	-6.19	4.66	-7.813	.000	-9.15	5.64	-9.5	.000	-8.96	5.47	-9.75	.000

* $p \leq 0.05$ Significant. The mean difference used as data in the table is the difference between the transmuted mean of the original pre-test and post-test scores

The preceding table confirms the test of difference between the mean pre-test and mean post-test of the groups exposed to different activating strategies as to their critical thinking subskills. It can be observed that there is a significant difference in the pre-test and post-test scores among the sub-skills in the critical thinking skills of the respondents exposed to the three above mentioned activating strategies at $p \leq 0.05$.

The critical thinking skills of the carousel group was enhanced, particularly the decision-

making skills. This result may be attributed to the likeness of the students to have groupings or collaboration among their groupmates specifically when making decisions on a particular scenario.

According to Lestari (2014), carousel brainstorming technique helps students to be more creative and have high self-confidence in such a way that all of them in the group are given opportunities to cite or write their ideas about a certain topic. It encourages students to exchange their ideas with their friends. It

encourages students to exchange their ideas with their friends and will steer to a new and meaningful learning.

Table 4 also depicts the mean differences in the critical thinking subskills of the respondents who were involved in challenge envelopes in their learning process. Focusing on the kinds of questions we ask in classrooms and the strategies we use can help us achieve this. Formulating challenging questions may be of help to enhance the thinking ability of the students. According to Hall (2016), questions are the most common form of interaction between pupils and teachers. To raise pupils' levels of achievement they therefore need regular practice in higher order thinking - analyzing, synthesizing, and evaluating. Focusing on the kinds of questions we ask in classrooms and the

strategies we use can help us achieve this. Formulating challenging questions may be of help to enhance the thinking ability of the students.

The mean differences in the critical thinking subskills of the respondents who were exposed to talking drawings in their learning process can also be observed. Generally, all the subskills in the pre-test and post-test were significantly different with $p \leq 0.05$. This may suggest that the critical thinking skills of the respondents have a noticeable improvement after exposing them to talking drawings since the students in this group are fond of making visual representations of their learnings. This helped them to enhance their skill particularly decision making. They explained their decisions in an organized, and knowledgeable manner.

4. Difference of Post-test scores of the groups exposed to their critical thinking skills

Table 5

Difference in the posttest scores of the groups exposed to activating strategies in terms of Critical Thinking Skills

Critical Thinking Skills	Mean Square	Frequency	p-value	Interpretation
Verbal Reasoning	104.64	4.08	.020	Significant
Argument Analysis	379.63	11.76	.000	Significant
Decision Making	67.27	1.81	.167	Not Significant

* $p \leq 0.05$ Significant

The data above describe the test of difference among the mean posttest of the three groups exposed to different activating strategies in terms of their critical thinking skills. The three activating strategies lead the respondents to achieve well, the post-performance scores of the three groups in decision making marked no significant difference with p value (.167) greater than 0.05. Opposing to the argument analysis and verbal reasoning subskills, which may suggest that there is a significant difference among the performances of the three groups.

The data may also specify that the three groups have similar performances as described by their post-test scores in the verbal reasoning

and decision-making subskills. However, in argument analysis subskill the groups showed differences. Hence one group perform better than the other. Some who got higher scores might perceive the items in argument analysis as easy while the others who got lower scores did not. In here, the critical thinking skills were affected by the activating strategies that the researcher utilized in the study. This may be due to the different sets of learning activities in each of the activating strategies.

5.Relationship between student preparedness and critical thinking skills as to verbal reasoning, argument analysis, and decision making

Table 6 highlights test of relationship between students' preparedness in learning physical science and their critical thinking skills.

Table 6*Test of Correlation of the Students' Preparedness in Learning Physical Science and their Critical Thinking Skills*

Indicators	Carousel Brainstorming Group			Challenge Envelopes Group			Talking Drawings Group		
	VR	AA	DM	VR	AA	DM	VR	AA	DM
Prior Knowledge	.229	.240	.257	.077	-.179	.067	.046	.026	-.307
Needs	.009	.011	.155	.016	.425*	.182	-.263	.005	-.252
Attitudes	.064	.157	.009	.029	.138	.067	-.102	.056	-.210
Interest	-.011	-.227	.206	.024	-.038	-.064	-.073	-.031	-.064

*Correlation is significant at the 0.05 level (2-tailed) **Correlation is significant at the 0.01 level (2-tailed)

Key to interpretation: VR- Verbal Reasoning, AA- Argument Analysis, DM- Decision Making

Based on the table, it can be observed that there are no significant relationships among variables such as prior knowledge, attitudes, and interest in Science subject and therefore has nothing to do with their critical thinking skills in terms of verbal reasoning, argument analysis, and decision making. It can also be perceived that r values were high but there was no significant relationship. This is due to the small sample size of the population. However, there is one variable which has a significant relationship, needs ($r = .425$) since its p value is less than 0.05 level of significance specifically on their argument analysis subskill.

This shows that the students' needs in learning science has extent influence on their argument analysis skill. The need to learn more on the different theories and explanations behind it as well as in learning the different theories and ideas can serve as evidences and proofs of a particular issue and to support an argument.

According to David (2015), encouraging students to use active techniques (experiments, real-world problem solving) to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing. The teacher makes sure she understands the students' preexisting conceptions and guides the activity to address them and then build on them. Learning about the students can also be of great help to the teachers. Knowing that each student has unique skills, abilities, and needs that need to be addressed, teachers can use variety of ways to achieve this like, soliciting their personal information, spending them with them, and engaging them in different activities. Considering other factors that may affect the learning of the students may be of great help, too.

CONCLUSIONS

The study found out the following results:

1. There is a significant difference in the pre-test and post-test scores of the three groups exposed to the different activating strategies as to verbal reasoning, argument analysis and decision making.
2. There is a significant difference in the mean post-test scores of the groups exposed to the different activating strategies as to verbal reasoning, argument analysis and decision making.
3. There is a significant relationship between student preparedness and critical thinking skills as to verbal reasoning, argument analysis and decision making.

RECOMMENDATIONS

Considering the findings and conclusions in the study, the following recommendations are hereby given:

1. Teachers may use various teaching strategies preferably the activating strategies so as not to make the interaction boring and as a part of the discussion to improve the achievement of the students in physical science.
2. The principals, parents, and supervisors are encouraged to provide help in any form and support on the use of the activating strategies for the improvement of students' critical thinking skills leading them to improve their performance in science.
3. Educators may first know the factors that can affect the learning of the students, much as the need in learning the subject matter.
4. Related studies may be conducted not only to strengthen the effectiveness of activating



strategies but also to disseminate the researches the usefulness of these strategies in any learning areas to increase the achievement of the students.

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