International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor (2018): 7.426

The Effect of Active Engagement Models on Students' Performance Scores in Biology

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Abstract: ***The study aims to determine which active engagement model would favorably impact Grade 7 students' performance scores in selected biology topics. Using quasi-experimental design, three groups of Grade 7 students enrolled in a public high school were randomly assigned to three treatments. The groups were compared in their performance in a validated researcher-made achievement test after 8 weeks of exposure to POGIL, Problem Based Learning (PBL) and Peer Lead Teaching Learning (PLTL) engagement models. ANCOVA results indicated that students exposed to PLTL had achieved significantly higher scores compared to the two other groups. This indicates that well-designed lectures followed by cooperative learning activities using peer leaders promote academic performance among the students.***

Keywords: active learning model, performance scores, PBL, POGIL, Peer-Led Learning, inquiry skills, cooperative learning

1. Introduction

The main purpose of education is to bring a fundamental change in the learner. Such changes may be in the form of acquiring intellectual skills, solving problems, and instilling desirable attitudes [1]. Teachers are encouraged to innovate their teaching strategies to improve the academic performance of the students. In addition, learning must become more social, authentic, adapted to individual motivations and abilities, reflective, and strategic. It also stated that the dominant concept of learning in 21st century is socio-constructivist, in which learning is understood to be importantly shaped by the context in which it is situated and is actively constructed through social negotiation with others.

The twenty first century is a new era shaped by a rapid change affecting both the individuals and organizations. In this new era educators and educational institutions are faced by the challenge of meeting the rapidly changing new demands of their communities and fulfilling the needs of the new generation learners [2].In addition, the ability to recognize the way people learn leads to the motivation to change the way we teach [3]. Each strategy for teaching that may lead to effective learning has particular emphases and applicability. Problem-Based Learning (PBL), Process-Oriented Guided Inquiry Learning (POGIL) and Peer-Led Team Learning (PLTL) are learning strategies under the tenets of social constructivism. These are active learning pedagogies commonly used in science education but their characteristic features are different [4].These strategies may eventually answer the call to innovate the teaching approaches. Moreover, PBL, POGIL, and PLTL strategies that provide rich array of options to innovate teaching approaches but the sustainability of one or the other for a particular situation will vary on the learners as audience, instructional tools, instructional goals, and personal preferences.

Active learning models are developed on the principles of constructivist theory. It is a student centered approach to learning and it assigns the responsibility of learning to the student. In order to ensure active learning in classrooms students should be self-regulated and have an active role in decision making process while engaged in cognitively challenging academic tasks. Active learning enhances the quality of student learning as students learn by creating meaning rather than memorizing information transmitted by the teacher [2]. Hence, PBL, POGIL and PLTL as active learning strategies intentionally create learning environments that stimulate students to construct a robust understanding of concepts wherein students are engaged in developing their own higher-order thinking skills [4].

These active learning models provide different engagement opportunities for the students while discussing course content in small groups. Despite the similarity in physical appearance associated with working groups in the classrooms, the structure of the group activities differ with respect to the student tasks and role of the instructor. Problem-Based Learning is driven by the premise that basic science concepts will be understood and remembered longer when they are learned, discussed, and applied in a practical, real-world context [4]. Students are given the opportunities to do problem-solving in a collaborative setting where learning is triggered by a problem which requires solution [5]. On the other hand, Process-Oriented Guided Inquiry Learning (POGIL) is developed on a principle of social constructivism [4]. Vygotsky states that cognitive growth occurs first on social level and then it can occur within the individual [6]. POGIL content mastery was not only developed through student construction of their own understanding but also enhanced important learning skills where POGIL approach involves creating a learning environment where students are working in a small, self-managed teams on specially-designed guided inquiry activities that follows a learning cycle paradigm [7]. Similarly, PLTL links the use of a trained peer-leader with small group work and integrates these into the structure of the course. Peer leaders serve as role models. The peer leaders also serve as a bridge between students and instructors [8]. It offers a mix of active-learning opportunities for students and a new role for peer leaders. At the same time, peer leaders manage the group dynamics and facilitate the collaborative problem-solving activities of the PLTL groups [4].

Teaching is a continuous process that involves bringing about desirable changes in learners through the use of appropriate methods that emphasizes production of quality learners' outcomes in teaching learning process [9]. In order to bring these desirable changes, educators must use teaching methods that are best for the subject matter [10]. Teaching methods will work effectively if they accommodate the learners' needs [11]. This is mainly because learners differ in the way they approach the learning process thereby forcing the teachers to innovate teaching strategies. Accordingly, good teaching is the result of exposing students to certain experience through adequate guidance and providing appropriate learning activities so that they will acquire the best form of learning [12]. Thus, this study aims to compare the three strategies (process-oriented guided inquiry learning, problem-based learning, and peer-led team learning) in teaching selected topics in biology with a view to determine which of the three active engagement learning models will be most effective in teaching selected topics in biology and will result to best learning gain.

2. Methodology

2.1 Research Design

The study made use of the quasi-experimental design where three intact groups of Grade 7 students were randomly assigned to three active engagement models. For the three treatment groups, selected topics in Biology were introduced to the students using POGIL, PBL, and PLTL approaches. These approaches differ mainly on the learning cycles.

The POGIL follows the learning cycle of exploration, concept formation and application. The POGIL class worked on models before the formal lecture of the teacher. This model can be a text explanation, diagram, table, graph, or another format that presents new information to the students. The purpose behind the model is to enable students to explore the characteristics of the model and derive concepts based on what the model illustrates [13]. These representations will be reflected on a worksheet that will be analyzed by the students. They answered the guide questions out from the patterns of the model.

For the PBL, the students were presented a problem scenario. They analyzed the problem by identifying relevant facts. The problem scenarios are related to the subject matter and these were reflected on their worksheets. The students were given time to understand the problem and organize their thoughts. Then, the students presented their prior knowledge about the topic and they were asked to write on what they want to know in the KWL chart. After this activity, the teacher conducted the lecture using the activity as the starting point of the discussion.

Lastly, the PLTL students were taught using 7E model which is the usual teaching approach applied by the researcher in her classes. Students learn through the presence of peer leaders who were selected on the basis of their academic performance. In this approach peer leaders have big role in the teaching learning process in which the teacher will just serve as facilitator. A workshop was designed for the training of the peer leaders. For the workshop activities, these will begin with a brief review of concepts in the previous workshop and the researcher as facilitator will give a brief introduction to the topic and was followed by a set of performance goals that identify what the student must do to demonstrate mastery of the workshop material. Moreover, the peer leaders were trained on how to handle the materials for the activity and how to go through with the procedure of the activity. For the teaching-learning process, the researcher considers the 7E (Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Extend) approach. First, the facilitator ask question as a sort of review. Then, an activity or a question that will engage the learners to the topic was given. Then, the students worked with the given activity with their peer leaders as their manager. Then, the students presented their understanding about the activity and the teacher elaborated the topic through questions and short discussion facilitated by the teacher.

POGIL and PBL students were set to their tasks first before formal instruction by the teacher while PLTL students were given first the lecture before doing the science activities. An observer was assigned to monitor the proper implementation of the experiment.

2.2 Research Setting and Participants

The research participants are composed of three intact classes of Anakan National High School at Anakan, Gingoog City, Misamis Oriental, Region 10, Philippines in the academic years of 2018 and 2019 respectively. The treatment groups are made up of three intact classes of seventh grade students (N=100), section A (N=34), B (N=33) and section C (N=33). Prior to the conduct of the experiment, the three classes were taught Life Science concepts using POGIL, PBL and PLTL approaches to make the students familiar with the learning process.

2.3 Research Instrument

The instrument Science Aptitude Test that was used to determine the performance scores of the students in biology was designed by the researcher. Face and content validity analysis of the instrument was conducted by three biology teachers. These biology teachers had taught biology courses for at least five years. The 40 item multiple choice test focused on the selected topics of Life Science namely the organisms, cell, asexual reproduction of plants, symbiotic relationship of organisms and ecological pyramid. It was validated using Grade 8 students enrolled in the same school and item analysis was performed to discard very difficult and very easy items as well as improve the test. The corresponding KR 20 reliability coefficient is 0.653 which indicates that the instrument is reliable.

2.4 Statistical Analysis

ANCOVA was used to analyze the data gathered. The analysis was conducted using SPSS statistical package software.

3. Findings

Data cleaning was performed. Only research participants with complete pretest and posttest participation were considered in the data analysis. Students who were also frequently absent from the class were excluded.

Table 1 shows the performance scores of the students exposed to three active engagement models.

Table 1: Descriptive Statistics for the Performance Scores

Groups	N	Mean		Standard Deviation	
		Pretest	Posttest	Pretest	Posttest
PLTL	27	11.30	22.52	3.30	4.34
POGIL	29	10.41	18.76	2.19	3.79
PBL	30	10.30	19.50	2.67	4.61

a. Covariates appearing in the model are evaluated at the following values: Pretest = 10.65.

Table 1 shows that the pretest and post test performance scores of learners taught in Science using the three Active Learning Approaches: Problem-Based Learning (PBL), Process- Oriented Guided Inquiry Learning (POGIL) and Peer-Led Team Learning (PLTL) did vary. The data shows that among the three approaches, the Peer-Led Team Learning has the highest mean post test scores (22.52). This is followed by the Problem-Based Learning (19.50) and Process-Oriented Guided Inquiry Learning (18.76) respectively. To determine whether the mean scores are significantly different, ANCOVA was performed.

Table 2: ANCOVA Results of Students' Performance Scores

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	574.890[a]	3	191.630	11.935	.000
Intercept	963.261	1	963.261	59.993	.000
Group	292.012	2	146.006	9.093	.000
Error	1316.610	82	16.056		
Total	34593.000	86			
Corrected Total	1891.500	85			

a. R Squared = .304 (Adjusted R Squared = .278)

ANCOVA results indicated that there is a significant difference between the groups in terms of their performance in the science aptitude test. To determine which group performed best than the other two groups, a post hoc analysis was conducted.

Table 3: Pairwise Comparisons for the Three Active Learning Approaches (PLTL,POGIL and PBL)

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
PLTL	POGIL	3.270*	1.081	.010	.628	5.911
	PBL	4.465*	1.075	.000	1.838	7.092
POGIL	PLTL	-3.270*	1.081	.010	-5.911	-.628
	PBL	1.195	1.044	.766	-1.355	3.746
PBL	PLTL	-4.465*	1.075	.000	-7.092	-1.838
	POGIL	-1.195	1.044	.766	-3.746	1.355

Based on estimated marginal means
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Bonferroni.

Table 3 indicates that students exposed to PLTL did better in the science aptitude test than students exposed to POGIL and PBL. On the comparison of the performance between POGIL and PBL students, it was found out that the difference in the mean scores in the aptitude test is not significant.

In this study, the researcher believes that the success of the PLTL group is due to the expectation of the students of the role of the teacher. Young learners expect the teacher to be the source of knowledge that they will use to accomplish their given tasks. In addition, assigning students with high cognitive ability, communication and leadership skills as the peer leaders made the group understand better the science concepts. If there is a need for clarification, the peer leader approaches the teacher to get the information and relay this information to the group thereby providing a very efficient conduit of relevant information necessary for the completion of the tasks. Moreover, the PLTL group was given the lecture format that has been used since the start of the school year that eliminates novelty of the leaning process as a hindrance to effective learning.

4. Discussion

Students are more engaged when they perceive that they are involved in the learning process and are provided with challenging tasks within their control such as what happens during group activities [13]. However, the challenges and skills must be balanced in a way that students may be able to address the challenge because they possess the skills. Students' motivation is related to the expectation to succeed [14]. Cooperative learning activities that follow every lecture are valued by students. Reasons provided by students' preference for cooperative learning groups include opportunity to participate in peer discussion to formulate and express opinions and critique their peer's ideas in order to make sense of their own learning process [15]. Teachers are encouraged to nurture the young learners' desire for autonomy and self-expression [16]. By doing this, students will be more motivated to learn under that nurturing environment.

5. Conclusion

Teachers plays the most crucial role in the development of the students. It is the educators' primary responsibility to design engaging and nurturing learning environment that will help the students attain their maximum potential. The students especially, young learners would need their teacher to provide guidance and to facilitate the learning journey. This teacher would know when to relinquish the control and little by little allow the learners to gain more autonomy to express their learning among their peers and to the teacher. This is possible when the teacher will always consider the needs of the students at all times.

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