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The Use of PBL (Problem-Based Learning) in Improving the Student Performance in Navigation 3 (Terrestrial and Coastal Navigation)

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Abstract: This quasi-experimental study aimed at looking into the effectiveness of PBL (problem-based learning) in improving the performance in Navigation 3 (terrestrial and coastal navigation) of BSMT (Bachelor of Science in Marine Transportation) second year students at JBLFMU-Arevalo during the first semester of school year 2016-2017. The respondents of this research were the two sections comparable with each other who was enrolled in the subject Navigation 3. There were 60 student respondents composed of 30 in the experimental group and 30 in the control group. A validated three item teacher-made problem solving test with 10 points for each correct answer was used as an instrument. The dependent variable was the scores in Navigation 3 and independent variable was the PBL approach. The statistical tools used were mean, standard deviation, Mann-Whitney test, and Wilcoxon-Signed ranks test set at 0.05 level of significance. The effect size was computed to determine the effectiveness of the PBL approach in terms of students' performance in Navigation 3. Results showed that in the pretest, though the experimental group had a higher mean than the control group, the Mann-Whitney test showed that the mean scores of the two groups were comparable because the significant value was greater than 0.05. When the treatment was introduced, findings showed that there were significant differences in the Navigation 3 performance in the pretest and posttest of experimental and control groups as well as in the posttests of both groups. It could be inferred that the better performance of the experimental group could be attributed to the intervention where the students were actively involved in the learning process.

Key words: Problem-based learning, terrestrial navigation, coastal navigation, quasi-experimental, JBLFMU-Arevalo.

1. Introduction

It cannot be denied that being a teacher today requires a vast and extensive toolbox of disciplines—from pseudo-parents fostering societal values, to psychologists who understand the individual needs of the students. To reach out all of our students we need to be equipped with the ability to modify our teaching methods to match their learning abilities. Teaching methods change, is disputed, and new methods are suggested as the pendulum swings between operant conditioning and constructivist theories of education. This supports the general consensus that motivation is critical for students' learning [1].

An important challenge for today's higher education focuses on the development and implementation of learning and teaching practices that will foster in students the skill to acquire and apply their knowledge efficiently, think critically, analyze, synthesize and make inferences [2]. Overall, it is claimed that "student-centered" or "new" learning environments have the potential to improve these educational outcomes for students in higher education [3]. New learning environments are rooted in constructivist theory and intend to develop an educational setting to meet the challenge for today's higher education, making the students' learning the core issue and defining instruction as enhancing the

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learning process. PBL (problem-based learning) is described as an inquiry-based approach to learning that is student centered and provides the means for gaining problem solving and life-long learning skills [4]. PBL begins with the presentation of an ill structured problem to be solved that has potentially multiple solutions. Teachers act as facilitators throughout the process, guiding learners with meta-cognitive questions, and learners actively construct knowledge by defining learning goals, seeking information to build upon prior knowledge, reflecting on the learning process, and participating in active group collaboration [5].

Furthermore, PBL is an instructional method of hands-on, active learning centered on the investigation and resolution of messy, real-world problems. It is an exciting alternative to traditional classroom learning.

In spite of the many variations of PBL that aim to match PBL with the specific educational or discipline context, for comparative research, a core model or basic definition is needed to which other educational methods can be compared. The six core characteristics of PBL as distinguished in Barrows' (1996) core model can be described as follows. The first characteristic is that learning needs to be student centered. Secondly, learning has to occur in small student groups. Thirdly, the presence of a tutor as a facilitator or guide is needed. Fourthly, authentic problems are primarily encountered in the learning sequence, before any preparation or study has occurred. Fifthly, the problems encountered are used as tools to achieve the required knowledge and the problem-solving skills necessary to eventually solve the problem. Finally, new information needs to be acquired through self-directed learning. It should be noted that just as the definition of PBL is ambiguous, the definition of what constitutes conventional instruction is also ambiguous. For the most part, conventional instruction is marked by large group lectures and instructor-provided learning objectives and assignments [6]. If one ponders on the implementation of PBL, a major question is: Do students from PBL reach the goals in a more effective way than students who receive conventional instruction? Albanese and Mitchell [6] pose this question as follows: "Stated bluntly, if PBL is simply another route to achieve the same product, why bother with the expense and effort of undertaking a painful curriculum revision?"

This study was conducted because of the following reasons: The instructors of the JBLFMU-Arevalo may benefit from the findings of this study. The results will provide them practical and practicable direction for more effective instruction inside the classroom.

The results of this study may likewise move school administrators to provide in-service seminars, workshops and training for their teachers for them to learn the problem-based learning approach model in teaching.

The students will certainly be benefited by the results of this study since these will inform them about the need to adjust to new instructional modes which may lead to better learning of their subjects.

This study aimed to determine the effectiveness of PBL in improving the performance in Navigation 3 (terrestrial and coastal navigation) among the second year BSMT (Bachelor of Science in Marine Transportation) students during the first semester of school year 2016-2017.

Specifically, this study sought answers to the following questions:

(1) What is the pretest score performance of the experimental and the control groups?

(2) What is the posttest score performance of the experimental and the control groups?

(3) Is there a significant difference in the pretest score performance between the experimental and the control group?

(4) Is there a significant difference in posttest score performance between the experimental and the control groups?

(5) Is there a significant difference in the pretest

and posttest performance of the experimental group?

(6) Is there a significant difference in the pretest and posttest performance of the control group?

(7) What is the mean gain of the control group and the experimental group?

(8) Is there a significant difference in the mean gain of the control group and the experimental group?

(9) How effective is the problem-based learning in terms of students' performance in Navigation 3?

2. Method

2.1 Research Design

A research design is the overall plan for collecting data in order to answer the research question. It is also the specific data analysis technique or method that the researcher intends to use [7].

The quasi-experimental method of research was employed in this study since the data collected were intended to find answers to questions concerning the relative effectiveness of problem-based learning in improving the performance of students in Navigation 3 (terrestrial and coastal navigation).

The study was quasi-experimental in view of the fact that it utilized an instruction-related treatment or intervention in one student group but no such treatment in another comparable group.

This two-group pretest-posttest quasi-experimental research design determines the effectiveness of problem-based learning in improving the performance in Navigation 3 (terrestrial and coastal navigation) among the second year BSMT students during the first semester of school year 2016-2017.

2.2 Respondents

The respondents of this research were two sections relatively comparable second year BS marine transportation sections of the JBLFMU-Arevalo in Iloilo City, who were enrolled in the subject Navigation 3 (terrestrial and coastal navigation) during the first semester of school year 2016-2017. There were a total of 60 students composed of 30 in the experimental group and 30 in the control group.

2.3 Instrument

A three-item teacher-made problem solving test with 10 points for each correct answer was used in this study. A rubric was made as a basis in checking the answers of the students.

The topics were taken from the midterm lessons which included the following: plane sailing, parallel sailing, and Mercator sailing. The study was conducted from August to October of the school year 2016-2017.

2.4 Data Collection

The data needed for this study were gathered through the use of achievement tests in pretest and posttest. The pretest was submitted for preliminary validation to a panel of jurors selected for their expertise in terms of content and appropriateness of instrument.

Pre- and post-tests were administered to both experimental and control groups. The tossing of coin was used to determine the experimental and control group. The head was assigned for experimental group and the tail for control group.

During the first-class session, the researcher administered the pretest to the experimental and the control group. This set of data was tagged as the "pre-course" data.

The experimental group and control group were handled by 2/M Mario B. Dumaicos, one of the researchers. The PBL group/experimental group of section Fomalhaut was taught according to PBL approach, such as group work, reporting, and demonstration. On the other hand, section Hadar in its non-problem based learning group/control group was taught the subject employing only the traditional lecture-class discussion method using the instructional/workbook for the subject. The intervention lasted for two months, i.e. 8 weeks during the first semester of school year 2016-2017.

2.5 Data Analysis

The statistical tools used in this study were the following:

Mean—used to determine the students' performance in the pretest and posttest.

Standard deviation—used to determine the level of the students' homogeneity in their Navigation 3 performance.

Mann-Whitney test—used to determine the significant differences in the pretests and posttests of two groups in Navigation 3 (terrestrial and coastal navigation) and for the significant difference in the mean gain of the pretest and posttest of the experimental and control groups set at .05 level of significance.

Wilcoxon-Signed ranks test—used to determine the significant differences in the pretest and posttest of two groups in Navigation 3 set at 0.05 level of significance.

Effect size—used to determine the effectiveness of the PBL approach in terms of students' performance in Navigation 3 (terrestrial and coastal navigation). This is done by using the means and standard deviation in the posttest among the experimental and the control groups.

3. Results

3.1 Performance between the Experimental and Control Groups

The pretest was initially conducted to determine the comparableness between the experimental and the control groups in terms of cognitive levels. The posttest was given to the respondents after the experiment.

Table 1 shows the pretest scores among the experimental and the control group.

Thirty students composed the experimental group and 30 for the control group.

The experimental group's pretest mean score was 14.87 (SD = 1.87) while the controls group's mean score was 14.30 (SD = 2.67).

It was noted that the experimental and control groups registered comparably the same mean scores in the pretest, indicating their almost identical cognitive levels before the experiment.

Table 2 shows the posttest scores among the experimental and the control groups.

The experimental group's posttest mean score was 27.43 (SD = 2.84) while that of the control group was 20.10 (SD = 1.94).

On the other hand, the experimental group manifested a higher mean score in the posttest than the control group, implying the experimental group's better performance in Navigation 3 after the experiment.

3.2 Significant Differences in Navigation 3 Performance between the Experimental and Control Groups

Table 3 reveals that the obtained significance value of 0.340 was higher than 0.05 which means that the two pretest mean scores showed no significant difference.

Table 4 shows that the obtained significance value is 0.000 lower than the significance value of 0.05 which indicates that the difference between the two mean scores was significant.

Table 1 Mean and SD for the students' pretest performance in Navigation 3.

Compared group	N	M	SD
Experimental	30	14.87	1.87
Control	30	14.30	2.67

Table 2 Mean and SD for the students' posttest performance in Navigation 3.

Compared group	N	M	SD
Experimental	30	27.43	2.84
Control	30	20.10	1.94

Table 3 Mann-Whitney test result for the significant difference in the pretest in Navigation 3 performance between the experimental and control groups.

Compared group	U	W	Z	Asymp. Sig. (2-tailed)
Experimental Control	386.50	851.50	-0.954	0.340

Table 4 Mann-Whitney test result for the significant difference in the posttest in Navigation 3 (terrestrial and coastal navigation) performance between the experimental and control groups.

Compared group	U	W	Z	Asymp. Sig. (2-tailed)
Experimental Control	19.50*	484.50	-6.50	0.000

Asterisk (*) means significant at 0.05 level of probability.

Table 5 Wilcoxon-Signed ranks test result for the significant difference between the experimental group's pretest and posttest in Navigation 3 (terrestrial and coastal navigation) performance.

Compared test	Z	Asymp. Sig. (2-tailed)
Pretest Posttest	-4.80*	0.000

Asterisk (*) means significant at 0.05 level of probability.

Table 6 Wilcoxon-Signed ranks test result for the significant difference between the control group's pretest and posttest in Navigation 3 (terrestrial and coastal navigation) performance.

Compared test	Z	Asymp. Sig. (2-tailed)
Pretest Posttest	-4.80*	0.000

Asterisk (*) means significant at 0.05 level of probability.

3.3 Difference between Pretest and Posttest in Navigation 3 (Terrestrial and Coastal Navigation) Performance among the Two Student Groups

The students' pretest and posttest mean scores were compared to determine the significance of their difference.

Table 5 shows that the obtained Z of 4.80, $p < 0.05$, revealed that there is a significant difference between the experimental group's performance before and after the treatment. The experimental group's performance after the treatment was significantly better than before the treatment.

Table 6 shows that the obtained Z of 4.80, $p < 0.05$, revealed the significant difference between the pretest and posttest score. The table further showed that the control group's posttest performance was significantly better than their pretest performance.

Table 7 shows the mean gains of the experimental and control groups. It shows that the mean gain in their scores in Navigation 3 (terrestrial and coastal navigation) of the experimental group is higher than the control group.

Table 8 shows that the obtained U of 25.50, $p < 0.05$ revealed that there is a significant difference in Navigation 3 (terrestrial and coastal navigation) mean gains between the experimental and the control groups.

The effectiveness of the PBL approach in terms of students' performance in Navigation 3 (terrestrial and coastal navigation) was quantified using the effect size. Using the means and standard deviation in the posttest among the experimental and the control groups, the value of the effect size is 0.81. This means that the percentile scores of the experimental group increased from 47th to 79th percentile.

Research has shown that students who actively engage in personal, self-directed inquiry investigations significantly outperform students who are taught using the straight lecture method. Cheng et al. [8] documented

Table 7 Mean gains between the experimental and control groups.

Compared group	Pretest	Posttest	Mean gain
Experimental	14.87	27.43	12.56
Control	14.30	20.10	5.8

Table 8 Mann-Whitney test for the significant difference in the mean gains between the experimental and the control groups.

Compared group	U	W	Z	Asymp. Sig. (2-tailed)
Experimental Control	25.50*	490.50	-6.30	0.000

Asterisk (*) means significant at 0.05 level of probability.

that interactive-engagement models and inquiry-based learning models, in comparison with the traditional passive lecture, allow students to construct more appropriate representations of physical phenomena.

4. Conclusions

The experimental group appeared to have learned significantly better in their Navigation 3 (terrestrial and coastal navigation) lessons after having been subjected to the PBL approach, than the control group. It was shown that the PBL approach was an effective tool in Navigation 3.

One vital implication of the research findings is that despite developments in the realm of instructional methods, approaches and strategies—in the end, there are only two important elements in the teaching-learning event: the teacher and the student, and that, as long as the teacher and the learner perform their respective tasks accordingly, delivery of lessons will be efficient and effective and the students will learn better.

Recommendations

Certain recommendations were advanced on the basis of the findings, conclusions and implications:

(1) In view of the significant effectiveness of PBL approach in teaching, it is highly recommended for use among teachers not only in Navigation but of other subjects as well;

(2) The use of PBL approach needs to be integrated in writing workbooks, modules and other instructional materials;

(3) Further or follow-up studies may be conducted to ascertain the results of this research. Other variables and data-gathering instrument can be employed. These other studies can help determine whether or not similar cognitive and non-cognitive outcomes will be obtained and if other subject areas and research venues are utilized;

(4) Maritime schools, such as the JBLFMU-Arevalo, and other educational institutions should conduct seminar-workshops to introduce to the instructors various teaching methods, techniques and strategies, with particular focus on PBL approach, for their appropriate use in their teaching of their subjects.

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