ISBN 978-602-74529-3-0

Proceeding

"Revitalizing Research And Education On Mathematics and Science for Innovations And Social Development"

5th ICRIEMS

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5th International Conference on Research, Implementation and Education of Mathematics and Sciences

"Revitalizing Research And Education On Mathematics and Science for Innovations and Social Development"

7-8 May 2018
Universitas Negeri Yogyakarta

ISBN 978-602-74529-3-0

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Revitalizing Research And Education
On Mathematics And Science For
Innovations And Social Development

Yogyakarta, 7 – 8 May 2018

FMIPA UNIVERSITAS NEGERI YOGYAKARTA

Proceedings of The 5th International Conference On Research, Implementation And Education Of Mathematics And Sciences (5th ICRIEMS): Revitalizing Research And Education On Mathematics And Science For Innovations And Social Development

Published by:
FMIPA Universitas Negeri Yogyakarta
Karangmalang, Yogyakarta 55281
Tel. (0274)550227, Fax. (0274)548203

ISBN 978-602-74529-3-0

Published by The Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-3-0

Preface

This proceedings is the regular edition (non-Scopus-indexed) of the conference proceedings of the 5th International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS) held by the Faculty of Mathematics and Science, Yogyakarta State University, Indonesia on 7 – 8 May 2017 at Eastparc Hotel Yogyakarta. All papers in this proceeding were obtained from a selection process by a team of reviewers and had already been presented in the conference. Some selected papers from the conference were compiled under separate proceedings and published by Institute of Physics (IoP) which is Scopus-indexed. This proceedings comprises 9 fields, they are mathematics, mathematics education, physics, physics education, chemistry, chemistry education, biology, biology education, and science education.

The theme of this 5th ICRIEMS is '*revitalizing research and education on mathematics and science for innovations and social development*'. This conference presented five keynote speakers, which were Prof. Dr. Fang-Ying Yang (Graduate Institute of Sciences Education, National Taiwan Normal University), Prof. Muammer Calik, Ph.D (Karadeniz Technical University, Turkey), Prof. Ferry Butar Butar, Ph.D. (Department of Mathematics and Statistics, Sam Houston State University, USA), and Prof. Dr. Eng Khairurrijal (Department of Physics, Bandung Institute Technology, Indonesia), and two invited speakers, which were Prof. (Assoc.) Dr. Azmi Mohamed (Department of Chemistry, Universiti Pendidikan Sultan Idris, Malaysia) and Dr. Lilla Adulyasas (Yala Rajabat University, Thailand). Besides the keynote and invited speakers, there were also parallel articles that present the latest research results in the field of mathematics, sciences, and education. These parallel session speakers came from researchers from Indonesia and abroad.

Hopefully, this proceeding may contribute in disseminating research results and studies in the field of mathematics, sciences and education such that they are accessible by many people and useful for the development of our civilization.

Yogyakarta, October 2018

Editorial Team

Published by The Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-3-0

Forewords From The Head of Committee 2018

Assalamu'alaikum warahmatullahi wabarakatuh.

On behalf of the organising committee of the 5th ICRIEMS, please let me welcome you to Yogyakarta, Indonesia. Nothing is more precious for us, besides enable to fete you all here, in the 5th of the International Conference on Research, Implementation, and Education of Mathematics and Science, that is organized by the Faculty of Mathematics and Science, Yogyakarta State University.

It is not only about the research as well as the papers that will be presented. But it is also about the academic networks, mutual cooperation, and meaningful communications amongst us – the researchers, academics, and educators – those which we are expecting to be built and established, in this conference. We believe that this occasion may lead our commitment to strength our roles together, particularly to achieve the innovation and social development through research and education on mathematics and science, as it is accentuated by the theme of this conference.

We are strongly considered that this conference would not be meaningful without other parties. Therefore, I would like to express my highest appreciation and gratitude to our keynote speakers and invited speakers. They are:

1. Prof. Ferry Butar Butar, Ph.D.,
2. Prof. Muammer Calik, Ph.D.,
3. Prof. Dr. Eng Khairurrijal, M.Si.
4. Prof. Dr. Fang-Ying Yang
5. Prof. Assoc. Dr. Azmi Mohamed
6. Dr. Lilla Adulyasas.

I also would like to address our big thank to our motivated and valuable participants. There are 570 papers will be presented and 2 posters displayed, out of 575 registered participants. A few selected papers would be published in the Scopus-indexed proceeding whilst others will be in either regular proceeding or journals.

We believe that there would be any shortcomings and inconveniences in this conference. Thus, we really apologize. We hope that this conference will be very succesful. Have a nice talk, discussion, and surely enjoy Yogyakarta. Thank you.

Wassalamu'alaikum warahmatullahi wabarakatuh.

Yogyakarta, May 2018

Agung W. Subiantoro

Published by The Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-3-0

Forewords From the Dean of Faculty of Mathematics and Sciences, Universitas Negeri Yogyakarta

Assalamu'alaikum warahmatullahi wabarakatuh. May peace and God's blessings be upon you all.

On behalf of the Committee, first of all allow me to extend my warmest greeting and welcome to the 5th International Conference on Research, Implementation, and Education of Mathematics and Sciences 2018, organized by Faculty of Mathematics and Natural Sciences (FMNS) Yogyakarta State University.

To celebrate the 54th Anniversary of Yogyakarta State University, our faculty has an opportunity to conduct the 5th ICRIEMS 2018 with the theme of Revitalizing Research and Education on Mathematics and Science for Innovations and Social Development. This conference proudly presents five keynote speeches by five fabulous speakers: Prof. Ferry Butar Butar, Ph.D., Prof. Muammer Calik, Ph.D., Prof. Dr. Eng Khairurrijal, M.Si., and Prof. Dr. Fang-Ying Yang and two invited speakers: Prof. Assoc. Dr. Azmi Mohamed and Dr. Lilla Adulyasas.

The independence of a country is impossible to gain if the education does not become the priority and it is not supported with the development of technology. We all know that the technology development could be achieved if it is supported by the improvement of firm fundamental knowledge. The empowerment of fundamental knowledge could not be separated from research which is related to the development of technology and the learning process in school and universities.

This conference is aimed to pull together researchers, educators, policy makers, and practitioners to share their critical thinking and research outcomes. Therefore, we are able to understand and examine the development of fundamental principle, knowledge, and technology. By perceiving the matters and condition in research and education field of mathematics and sciences, we could take a part in conducting qualified education to reach out the real independence of our nation.

This conference will be far from success and we could not accomplish what we do without the support from various parties. So let me extend my deepest gratitude and highest appreciation to all committee members. I would also like to thank each of participants for attending our conference and bringing your expertise to our gathering. Should you find any inconveniences and shortcomings, please accept my sincere apologies.

Wa'alaikumsalam warahmatullahi wabarakatuh.

Yogyakarta, May 2018

Dr. Hartono

Conference Program

THE 5th INTERNATIONAL CONFERENCE ON RESEARCH, IMPLEMENTATION & EDUCATION OF MATHEMATICS AND SCIENCES (ICRIEMS) 2018
7-8 MAY 2018, HOTEL EASTPARC, YOGYAKARTA, INDONESIA

#DAY 1: MONDAY, 7 MAY 2018

TIME	PROGRAM
07.00 – 08.00 AM	Registration
08.00 – 09.00 AM	Opening Ceremony 1. Opening 2. National Anthem: 3. Traditional Dance: 4. Welcome Speech: Chairman of ICRIEMS 2018 5. Opening Conference by Rector of YSU 6. Photo Session
09.00 – 09.30 AM	Tea/Coffee Break
09.30 – 12.00 PM	**Keynote Speech #1 :** **Prof. Ferry Butar Butar, Ph.D.** **Keynote Speech #2 :** **Prof. Dr. Eng Khairurrijal, M.Si**
12.00 – 01.00 PM	Lunch Break
01.00 – 05.00 PM	Parallel Sessions & Coffee Break

#DAY 2: TUESDAY, 8 MAY 2018

TIME	PROGRAM
07.00 – 08.00 AM	Registration
08.00 – 09.30 AM	**Keynote Speech #3:** **Prof. Muammer Calik, Ph.D**
09.30 – 10.00 AM	Tea/Coffee Break
10.00 – 11.30 AM	**Keynote Speech #4:** **Prof. Dr. Fang-Ying Yang**
11.30 AM – 00.30 PM	Lunch Break
00.30 – 04.00 PM	Parallel Sessions & Coffee Break
04.00 – 04.30 PM	Certificate Collection

#DAY 3: WEDNESDAY, 9 MAY 2018

TIME	PROGRAM
07.00 AM – 05.00 PM	City tour

The Effect of Project Based Learning as Learning Innovation in Applied Physics

by Chairatul Umamah

Submission date: 17-Jul-2020 08:26AM (UTC+0700)
Submission ID: 1358439354
File name: PE09_Chairatul_Umamah.pdf (373.55K)
Word count: 3402
Character count: 19502

5th ICRIEMS Proceedings
Published by Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-3-0

The Effect of Project Based Learning as Learning Innovation in Applied Physics

Chairatul Umamah[1)], Herman Jufri Andi[2)]

1Physics Education Study Program, Faculty Of Teacher Training And Education, Madura Islamic University
JL PP Miftahul Ulum Betet Pamekasan, Madura

[1)] chairatul.physics@gmail.com [2)] hermjufriandi@gmail.com

Abstract. This study aims to identification the effect of project-based learning model for student learning out comes in applied physics. This study confirm the student learning out comes before treatment and after treatment. This study is an experimental research with pretest posttest control group design. The experimental method which used was quasi experimental with pretest-posttest control group design. In this study, there are two classes will be used, one class is given an experimental treatment and one class is treated as a comparison. One class that were given experimental treatment were taught using project based learning (PjBL) model, and other class treated as a comparison (control) was taught using inquiry learning models. Experiment class is consist of 22 students and control class consist of 22 students. At the end of learning evaluation is done by giving posttest, then the data obtained from the evaluation questions in the experimental and control classes are analyzed with appropriate statistics. The results of normality test of experimental class data and control class are normally distributed. The results of homogeneity test is homogeneity. And hypothesis test, it indicated that there is an influence of the project based learning learning model on achieving student learning outcomes. it can be concluded that experiment class has achievement of learning outcomes that are significantly higher than the control class.

Keywords:

INTRODUCTION

Education serves to help student in their self development, namely the development of all potential skills and personal characteristics to be positive, both for their self and their environment. Education was developed as an instrument to guide student being qualified human which capable and respond proactively to answer the ever changing of modern era[2]. The development is done to create competent and characterized generation in carry out activities in accordance with their expertise. In globalization era, competition in education is getting complicated. Only competence people who can survive in competition, that is why Madura Islamic University (UIM) started the process towards a world class university. In order to improve the quality of education towards world class university (WCU), it takes more efforts, both on academic activities, as well as on efforts to improve quality in all aspects of campus activities. Improving learning quality of learning in study program both in terms of materials, processes, and evaluation is one of the main factors that must be done to development academic process[10].

One of activities to support world class university program is improving the quality of learning, include in Applied Physics courses. Applied Physics Course is connecting course between theory and application that requires critical thinking skills, high creativity and good physical concepts in producing contextual work both individually and groups. The result of work will be evaluated through skills competency assessment with practice and project tests. This course emphasizes that students can be innovation in applied of physics that they have learned.

The findings stated that learning activities in some subjects for Physics Education study Program include Applied Physics are generally the implementation in class is teacher centered learning (TCL). Actually, learning process is

depend on the role of lecture in present information, lecturers use discussion method only and giving task in the learning process. Students are less involved in the Physics learning process, so that creativity, motivation and critical thinking ability students' is less. Learning process in Physics Education Study Program are still more focused on learning outcomes in the form of knowledge only. It is very superficial only up to the level of knowledge (C1), comprehension (C2) and application (C3), it has not been much touched on aspects of analysis (C4), evaluation (C5), and synthesis (C6). This means that generally, learning process has not invited students to apply, every element process of concept learned to synthesis generally, and has not invited students to evaluate (think critically) on the concepts and principles that have been studied. Meanwhile, aspects of psychomotoric and attitude is also much neglected.

From pretest data, the result show that student competence in Applied Physics are inhomogeneous distribution of value. As many as 20% of students are in good level competence, 22.5% are in sufficient level competence and 50% are in low level competence and 7.5% student are in very low level competence. This condition causes difficulties for lecturers in implementation learning process. Given the importance of mastery competencies given in applied physics, so that needs to be pursued innovation model with experiment. innovation learning model which can increase student ability and motivation that ultimately will be improve learning outcomes. Learning model that have been still monotonous and theoretical based classes must to be changed with learning model which more involving students and field based learning. The goal of the use of innovation learning models is to improve the quality or competence of graduates.

In this study, one of learning model that leads to create an activity atmosphere that can be increase of skills, creativity and subsequently improve students learning outcomes (cognitive) in applied physics course through planning activities and field activities is Project Based Learning (PjBL). The focus of PjBL is in concepts and main principles of discipline study, so that allowing students to work autonomously to construct their own knowledge. It is hoped that the use of PjBL model in applied physics course can improve students' creativity thinking ability, skill and motivation which certain can be influence for student learning outcomes in producing a product (works) within a certain period of time collaboratively, then the results will be presented[4].

PjBL is learning model or approach innovative learning, which emphasizes contextual learning through complex activities [5]. The focus of learning is concept and the main principles of discipline study, involving student to investigation of problem solving and activities of other meaningful tasks, and reach the peak of producing of its products [3]. PjBL asks a question or poses a problem that each student can answer. PjBL asks students to investigate issues and topics addressing real world problems while integrating subjects across the curriculum. The characteristics of PjBL are developing student's thinking skills, allowing them to have creativity, encouraging them to work cooperatively, and leading them to access the information on their own and to demonstrate this information. PjBL usually require students to participate willingly in the meaningful learning activities proposed, mostly teamwork[11].

Other Research which related with PjBL has been widely implemented. PjBL has step guidance: planning; Creating (create or implement); Proccesing [9]. According other references show that using PjBL in biology program that students learning outcomes is increase on the aspects of cognitive, affective, and process skills [5]. Other research conducted the study about the influence of PjBL on the attitude of physics, student achievement and development of scientific process skills, how's that this learning improves the attitude of the skill they are on the study of physics and students' scientific process skills [12]. [1] show the result that project-based learning can improve motivation and high-level thinking and enrichment students in solving problems. Learning process using PjBL has the following advantages [6]:

1. Increase learning motivation
2. Improve problem-solving abilities
3. Improve collaboration
4. Improve the skill of managing resources
5. Improve social relationships and communication skills
6. Preparing students on employment
7. Increase of student confidence
8. Give students opportunity to develop individual learning skills

When student work in teams, they discover the skills plan, organize, negotiate, and make investigation about issue of the task, who is responsible for each task, and how information will be collected and presented. In group work of project, individual strength and the referred learning method reinforce the team's work as a whole.

Table 1. Steps of Project Based Learning [7]

No.	Phase	Description
1.	Start With the Essential Question	Learning process begins with the essential question and question can give the students assignment (student) in doing an activity.
2.	Design a Plan for the Project	Planning is done collaboratively between lecture and student. Planning is contains the rules of game, selection of activities that can be supportive in answering essential questions, by integrating possible subjects, and knowing the tools and materials that can be accessed to assist in project completion.
3.	Create a Schedule	Lecturers and student collaboratively arrange an activity schedule in completing the project.
4.	Monitor the Students and the Progress of the Project	The teacher is responsible for monitoring the student activities during completing project. Teacher's role as a mentor for the activities of students. In order to facilitate the monitoring process, a rubric is created that can be record all the important activities.
5.	Assess the Outcome	Assessment is done to help lecture on measure standard achievement, play a role in evaluating each student's progress, provide feedback on the level of understanding of student has achieved, assist the lecture in preparing the next learning strategy.
6.	Evaluate the experience	At the end of the learning process, lecture and student reflect on the activities and outcomes of projects that have been implemented. The reflection process is done both individually and in groups.

METHODS

The type of research which is used in this study is experiment. Experimental research method can be interpreted as a research method used to find out the influence of certain treatments on others under controlled conditions[10]. The experimental method which used was quasi experimental with pretest-posttest control group design. In this study, there are two classes will be used. one class is given an experimental treatment and one class is treated as a comparison. One class that were given experimental treatment were taught using project based learning (PjBL) model, and other class treated as a comparison (control) was taught using inquiry learning models. Experiment class is consist of 22 students and control class consist of 22 students. At the end of learning evaluation is done by giving posttest, then the data obtained from the evaluation questions in the experimental and control classes are analyzed with appropriate statistics. This is done to find out students' learning outcomes at the end of the material that has been delivered. Data analysis is done quantitatively with SPSS 20.0 for windows to identification the effect of PjBL treatment for student learning outcome and motivation in applied physics.

Table 2. Research Design of Pretest Posttest control Group design

Pretest	Treatment	Posttest
O1	X1	O2
O3	X2	O4

Explanation:

O_1 = Measurement the initial ability of experimental group (Pretest)
O_2 = Measurement final ability of experimental group (posttest)
X_1 = project based learning treatment
X_2 = inquiry treatment
O_3 = Measurement the initial ability of control group
O_4 = Measurement final ability of control group

Table 3. Indicator for Student Learning Outcomes [8].

Aspect	Competence	Indicator
Cognitive	Knowledge (remembering previously learned information)	Arrange, define, describe, duplicate, identify, label, list, match, memorize, name, order, outline, recognize, relate, recall, repeat, reproduce, select, state
	Comprehension (grasping the meaning of information)	Classify, convert, defend, describe, discuss, distinguish, estimate, explain, express, extend, generalize, give examples, identify, indicate, infer, locate, paraphrase, predict, recognize, rewrite, report, restate, review, select, summarize, translate
	Application (applying knowledge to actual situations)	Apply, change, choose, compute, demonstrate, discover, dramatize, employ, illustrate, interpret, manipulate, modify, operate, practice, predict, prepare, produce, relate, schedule, show, sketch, solve, use, write
	Analysis (breaking down objects or ideas into simpler parts and seeing how the parts relate and are organized)	Analyze, appraise, break down, calculate, categorize, compare, contrast, criticize, diagram, differentiate, discriminate, distinguish, examine, experiment, identify, illustrate, infer, model, outline, point out, question, relate, select, separate, subdivide, test
	Evaluation (making judgments based on internal evidence or external criteria)	Appraise, argue, assess, attach, choose, compare, conclude, contrast, defend, describe, discriminate, estimate, evaluate, explain, judge, justify, interpret, relate, predict, rate, select, summarize, support, value
	Synthesis (rearranging component ideas into a new whole)	Arrange, assemble, categorize, collect, combine, comply, compose, construct, create, design, develop, devise, design, explain, formulate, generate, integrate, manage, modify, organize, plan, prepare, propose, rearrange, reconstruct, relate, reorganize, revise, rewrite, set up, summarize, synthesize, tell, write

RESULTS AND DISCUSSION

Normality Test

The normality test is done to find out the data comes from a population that is normally distributed or not. The statistical test that will be used is taking a significance level of $\alpha = 0.05$ with the following statistical hypothesis:

H_0: Data of students' learning out comes is come from a population that is normally distributed.

H_1: Data of students' learning out comes is come from populations that are not normally distributed.

The test criteria are: H_0 is accepted if the significance value> 0.05 and H_0 is rejected if the significance value is <0.05. The results of normality test for the experimental class data are presented in Table 4, while the control class data are presented in Table 5.

Table 4. Normality Test of experiment class

		Posttest learning outcomes
N		22
Normal Parametersb,c	Mean	72.0000
	Std. Deviation	9.69717
Most Extreme Differences	Absolute	.182
	Positive	.182

	Negative	-.108
Test Statistic		.182
Asymp. Sig. (2-tailed)		.082d

a. class = Experiment
b. Test distribution is Normal.
c. Calculated from data.
d. Lilliefors Significance Correction.
e. This is a lower bound of the true significance.

Table 5. Normality Test of control class

		Posttest learning outcomes
N		22
Normal Parametersb,c	Mean	62.8788
	Std. Deviation	11.78715
Most Extreme Differences	Absolute	.155
	Positive	.155
	Negative	-.106
Test Statistic		.155
Asymp. Sig. (2-tailed)		.186d

a. class = control
b. Test distribution is Normal.
c. Calculated from data.
d. Lilliefors Significance Correction.
e. This is a lower bound of the true significance.

The results of normality test of experimental class data and control class according to Table 4. and Table 5. respectively have p-values are 0.082 and 0.186. Pretest and posttest data have p-value> α ($\alpha = 0.05$), it is indicated that H_0 is accepted. Thus, according to Kolmogorov Smirnov's test, it can be concluded that experimental class data and control class are normally distributed.

Homogenity Test

Homogenity test is done to determine the variance of homogeneous data or not. The statistical test that will be used is taking a significance level of α of 0.05. with the statistical hypothesis as follows:

H_0: Both data have homogeneous variances

H_1: Both data have non-homogeneous variance.

The test criteria are: H_0 is accepted if the significance value> 0.05 and H_0 is rejected if the significance value is <0.05.

Table 6. homogeneity test

Variable	F	df1	df2	Sig.
Learning outcomes	2.105	1	42	.155

The results of homogeneity test for students learning outcomes data according Table 6. have p-value of 0.155> α ($\alpha = 0.05$). Thus, we can conclude that data is homogenity and H_0 is accepted.

Hypothesis Test

Hypothesis test is done to find out whether there is influence from the use of project-based learning models for learning outcomes, then hypothesis test can be done using the t-test statistical test, with the provisions of the hypothesis as follows:

H_0: there is no significant effect of using PjBL model on student learning outcomes.

H_1: there is a significant effect of using PjBL model on student learning outcomes.

A summary results of anacova for students learning outcomes using project based learning is shown in Table 7.

Table 7. anacova analysis for the effect of PjBL for learning outcomes

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4635.018a	2	2317.509	96.059	.000
Intercept	14.740	1	14.740	.611	.439
Xhasilbelajar	3763.436	1	3763.436	155.992	.000
Kelas	1195.007	1	1195.007	49.532	.000
Error	940.908	41	24.126		
Total	195366.667	44			
Corrected Total	5575.926	43			
a. R Squared = .831 (Adjusted R Squared = .823)					

Based on the results of anacova test in Table 7., it can be seen that F calculated treatment difference in learning model is 49.532 with p-value = 0,000. p-value $<\alpha$ ($\alpha = 0.05$). Thus, H_0 which reads no difference in the achievement of learning outcomes between the two classes is rejected. Thus, the research hypothesis which reads that there is a difference in achievement of learning outcomes between two class of experiments class and control class is accepted. That is, there is an influence of the project based learning learning model on achieving student learning outcomes.

Table 8. average corrected of learning outcomes

Class	Pretest	Posttest	Difference	Enhancement	Average corrected
Experiment	54.667	72.000	17.333	31.71%	72.836
Control	56.061	62.879	6.818	12.16%	62.118

The average corrected for learning outcomes of two classes are presented in Table 8. Based on Table 7. and Table 8. it can be seen that experiment class has achievement of learning outcomes that are significantly higher than the control class.

CONCLUSION

Based on the result of analysis data and discussion, it can be concluded that there is a significant effect of using project based learning for students learning outcomes in applied physics course. it can be seen that experiment class has achievement of learning outcomes that are significantly higher than the control class.

ACKNOWLEDGMENTS

This research was supported by DRPM Kemenristekdikti. We thanks to kemenristekdikti who provided insight and expertise that greatly assisted the research, although still no perfect with all of the interpretation of this paper.

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The Effect of Project Based Learning as Learning Innovation in Applied Physics

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