Proceeding

The 4th International Seminar on Science Education

Bandung, 30 October 2010

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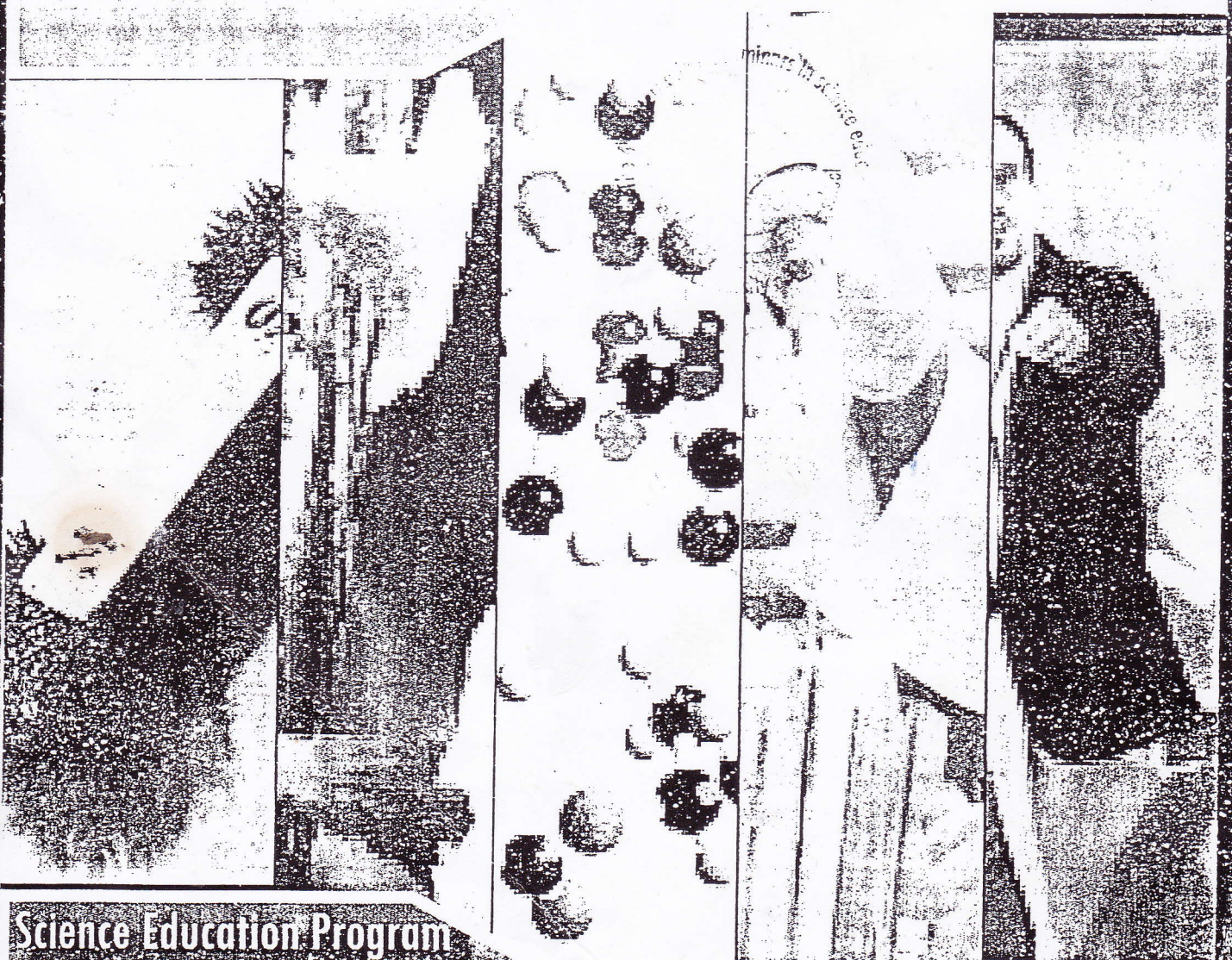
"Curriculum Development of Science Education in 21st Century"



Science Education Program
School of Postgraduate Studies
Indonesia University of Education

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"Curriculum Development of Science Education in 21st Century"

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Foreword of Chair of Science Education Program

The fourth International Seminar of Science Education is conducted to fulfill annual agenda of the School of Graduate Studies, Indonesia University of Education.

The seminar theme "Curriculum Development of Science Education in the 21st Century" is chosen emerge from many problems of science education in Indonesia. One of them is the overstuffed condition of science curriculum that affected from rapid development of information in this era. Besides, there are challenges of Indonesian people in facing against global competition. To win the competition they have to think critically. Therefore many massages have to cover by science curriculum caused it overloaded and difficult to be implemented.

We are not able to overcome the problem ourselves. We need input of information and experience from many researchers all over the world. Therefore this seminar hoped to be an exchange experience to solve the problem and lead to the discovery of science curriculum to enhance Indonesian science education quality.

I would like to express my special gratitude to Prof Dr Bruce Waldrip from Monash University, Australia; Prof Dr Russell Tytler from Deakin University, Australia; and Dr. Benny H.W.Yung from The University of Hongkong; who are specially come here to be key note speakers. Thank you for sharing the result of your latest result with us.

Finally I would like to thank to the committee who have been working hard to prepare the seminar and publish the proceedings. Last but not least thank you for all speakers and participants of your contribution today.

Bandung, 31 October 2010
Chair of Science Education Program
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Prof.Dr.Liliasari,M.Pd

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Table of Content

PROCEEDING
ISBN: 978-979-99232-3-3

PROCEEDING
ISBN: 978-979-99034-3-3

Chemistry Education

Physics Education

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THE DEVELOPMENT OF PROBLEM SOLVING SKILLS THROUGH INSTRUCTION IN OPTIC FOR PHYSICS EDUCATION STUDENT

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(*Bengkulu University, **Indonesia University of Education)

Abstract

A study using quasi-experiment with one group pretest-posttest design was carried out to improve students' physics concept understanding and students' problem solving skills. The freshmen (First year students) who enrolled in Basic Physics course at physics education department in one of Teachers College in Bengkulu province were involved as research subjects. The treatment was given to one group of students who was following course in instruction program with problem solving strategy. Research data was collected by using a concept understanding test and problem solving skills test. Data was then analyzed based on normalized gain score. Result of the research shows that N-gain of students' concept understanding and students' problem solving skills significantly improved. Average N-gain of students' concept understanding was 0,811 for higher level, 0,67 for middle level, and 0,41 for lower level. For students' problem solving skills, average N-gain was 0,734 for higher level, 0,46 for middle level, and 0,368 for lower level.
Keywords: problem solving strategy, concept understanding, problem solving skills One paragraph (font: Candara 9pt reguler)

Background

Learning physics in college generally place more emphasis on mastery of concepts and do not develop thinking skills (problem solving skills.) Learning in the classroom needs to be associated with a real situation where students are in, encouraging students make connections between physics concepts owned by its application in everyday life in society, so that more meaningful learning. As such, students need to be conditioned in learning situations that allow students to understand and understand the meaning of learning, the benefits and the role and status in the learning process. If a student can comprehend and understand it, the student will strive to achieve and require faculty as mentors and facilitators.

The process of learning the daily / regular lecturer proved yet done optimally to develop problem solving skils of students. It can be seen from the inability of students in solving problems encountered in life. Learning more usual to provide theories that are not rooted in the real world of students. This is the background presence of an innovative learning program to help students understand / master the concepts and thinking skills by associating the material with real life students. Regular learning which only produce mastery of concepts, needs to be improved by implementing learning programs that not only can enhance the mastery of concepts but also to improve the ability to think. The importance of developing thinking skills is supported by the results of a survey conducted by the American Institute of Physics (AIP) in U.S.. The survey results indicate that the skills most often used by workers S2 and S3 physics graduates is proficiency in solving problems, working groups, and communicate. Knowledge of subject matter the frequency of usage in the workplace on average only about a quarter compared to the use of problem solving skills (van Heuvelen, 2001).

Some physicists claim that problem solving is seen as a fundamental part of learning physics (Heler, Keith, & Anderson, 1992). Problem solving is one method of learning that can be used in teaching physics as physics of matter in accordance with the content (Gok & Silay , 2008). From the opinions of experts in the above can be said that problem solving skills be the focus of purpose in learning physics.

Topics optics, especially in optics geometry is one of the subject matter of basic physics. This material covers the study of reflection, refraction, color descriptions, and optical instruments. Characteristics of the material is quite abstract and involves a lot of reasoning affect students understand the difficulty to understand the concept.

Learning program with problem solving strategies used in this study is expected to help prospective teachers improve understanding / mastery of physics concepts and develop problem solving skills. In learning with problem solving strategies, prospective teacher will be involved mentally and physics to solve a given problem. Learning program with a strategy for physics problem solving is to follow five steps are: 1) Focus the Problem, 2) Describe the Physics, 3) Plan a Solution, 4) Execute the Plan, and 5) Evaluate the Answer (Heller & Heller, 2000; Kyurshunov, 2005; Yousuf & Chaveznava, 2006).

The study of thinking ability of students revealed that problem solving skills are not developed without an explicit and deliberate effort invested in its development. A student will not be able to develop problem solving skills with good if not trained to think solving problems in the field of study he had learned. The purpose of this research is to improve the mastery of concepts and problem solving skills of prospective teachers.

Method

This research used quasi-experimental research design with a "one group pretest-posttest design" (McMillan and Schumacher, 2001). This design provides a treatment of research subjects without compared with the control class, then compare whether there are significant differences between pretest and posttest. The subject of this research is a student of physics teacher candidates, in a LPTK in Bengkulu by the number of 32 individuals from one class who took the course Physics 2. Research subjects are classified into three groups of achievement, namely the achievement of top, medium, and bottom.. To collect the necessary data in this study used research instruments in the form of a test of understanding the concept in the form of multiple choice test which is expanded (the amount of about 30 items to the topic of color, reflection, and refraction, as well as 20 items about the topic optical instruments) and physics problem solving ability test in the form of an essay test amounted to 17 items.

To find out the problem soving skill enhancement of students is done by calculating the normalized gain (N-gain / g). Normalized gain score is also used as a basis for determining the effectiveness of learning programs.

The equation used to calculate the N-gain are: (Hake, 1999)

$$g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

Here is explained that g is the normalized gain (N-gain), S max is the maximum score (ideal) from the initial test and final test, S post is the final test score, while the S pre is the test score

early. High or low normalized gain (N-gain) can be classified as follows: (1) if $g \geq 0.7$, the N-gain resulting in higher categories, (2) if $0.7 > g \geq 0.3$, then N-gain generated in the medium category, and (3) if $g < 0.3$, then the resulting N-gain in the category low.

Discussion

Dragnet mastery of physics concepts using the concept mastery test an expanded form of multiple choice. Data from increasing student mastery of concepts obtained on each subject matter in optics can be seen in Table 1.

Table 1 Data Concept Mastery Test Results

No.	Topic Content	Group	Average Pretest	Posttest	N-Gain (%)	Information
1	Color	Top	0.9286	4:07	77,16	High
		Medium	0.6176	3.76	71,71	High
		Low	0.688	3.000	53,62	Medium
2	Reflection	Top	1:26	4.27	80,48	High
		Medium	1.1	3.84	70,26	High
		Low	0.95	3:06	52,10	Medium
3	Refraction	Top	1:24	4:19	78,46	High
		Medium	1:09	3.73	67,52	Medium
		Low	1:07	3:03	49,87	Medium
4	Optical Tools	Top	26.571	86.571	81,71	High
		Medium	22.529	73.294	65,53	Medium
		Low	20	51	38,73	Medium

In Table 1 shows that the acquisition of the normalized gain for each topic to the top is in the high category. While the acquisition of the

normaiized gain scores for each topic for the group under the middle category. For medium-only group on the topic of color who are at high category.

Recapitulation average score based on your level of mastery of concepts can be seen in Figure 1.

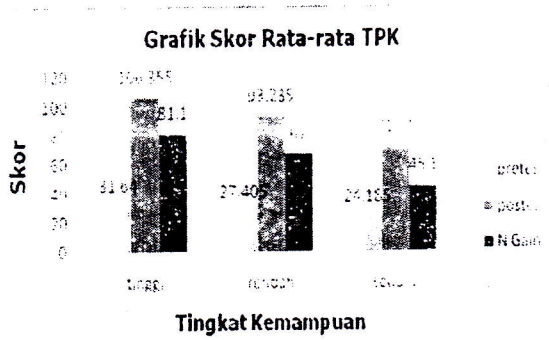

Figure 1. Comparison of Average Score pretest, posttest, and N-gain mastery of concepts

Data Results Physical Ability Test Problem solving

The ability of problem solving expressed by using the instrument in the form of an essay test. The average score for each aspect class problem solving skills of each group are shown in Table 2.

Table 2 Problem solving skills Prospective Teacher

Group	No.	Sub Problem Solving Skills	Average Score Pretest	Posttest	N-Gain (%)
Top	1	PU	2.47	4.24	70,44
	2	PF	2.7	4.14	71,18
	3	PM	2.14	4.28	73,80
	4	SP	2,00	4,35	78,56
Top Group Average			2,32	4,32	73,49
Secondary	5	PU	2,03	3,58	60,55
	6	PF	2,11	3:42	47,30
	7	PM	2,00	3,00	33,30
	8	SP	1,47	3:00	43,14
Average Secondary Group			1,9	3,75	46,07
Under	9	PU	1,95	3.50	59,20
	10	PF	1,88	3.15	46,25
	11	PM	2,00	2,50	22,91
	12	SP	1,50	1,87	18,93
Average Down Group			1,52	3,5	36,82
Total Average			1,7	3,85	53.90
Standard deviation (s)			0,400	0,423	0,096

Description PU = General Approach, PF = Physical Approach, PM = Procedure Mathematics, and SP = All Solutions

In Table 2 shows that the increase in ability occurs in all aspects with the increase in the average score of the normalized gain (N-Gain) is about 63.90% with a standard deviation of about 0.096. Improved ability to gain a normalized score for that included in the medium category.

To provide a clearer picture of the data, the average score of problem solving skils based on ability level is presented in Figure 2.

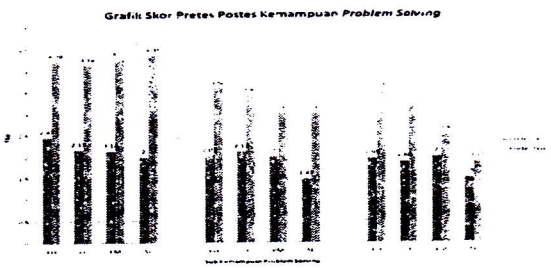

Figure 2 graphs average score of problem solving skils between the pretest and posttest

Based on the analysis of data obtained by the mastery of the concept of pretest and posttest, students experienced an increase after learning. Overall, teacher candidates obtain the normalized gain scores included in the high category (N-Gain for the high group average is 0.81) and moderate (N-Gain for the middle class and below each average is 0.67 and 0.451). Though not tall, but can be argued that the program is applied effectively enhance students' mastery of concepts to the topic of optics. The effectiveness of this learning was analyzed by performing the acquisition value of the pretest and posttest scores are expressed with the normalized gain. This is consistent with research conducted by Galili and Hazan (2000) who studied the effectiveness of teaching optics to show the difficulties of students in their understanding of optics. Results showed that students had difficulty about the light that shines is accepted as an object observed by the eye. This research is also consistent with research conducted by Yap & Wong (2007) who studied the aspects of the process of problem solving and understanding of the concept after learning the concept of a flat mirror. The results showed that

the majority of students who can explain the way light and shadows formed by the flat mirror is complete (using a sketch) and still there is something wrong in painting the course of rays, and still there are students who portray that angle ≠ reflection angle.

Based on the results of data analysis, problem solving skils of students can be concluded that the average gain-normalized average of .639 was the students' ability in solving the problem is still low, because the middle category. However, the learning program with problem solving strategies in this study is quite effective to improve the ability of prospective teachers' problem solving. The result is in line with research conducted by Selçuk, Çalışkan and Erol (2008) who studied the effect of teaching with problem solving in learning achievement , the performance of problem solving and use of probiem solving strategies used in teaching physics at the beginning of college. The results showed tnat teaching is an effective strategy for achievement of learning and problem solving performance as well as having a positive effect on students' physics

If the review is based on group performance was only a student at the high group that has categorized problem solving skills of high (<g> = 0.734), while the middle class and below only has the ability to problem solving are categorized (each successive are <g> = 0.460 and <g> = 0,368). Cause who can put forward here is the top group students who started to get used to practicing with the problems of physics, both from his teacher at school or through the guidance of learned that they follow. At low and medium groups while in high school found that they rarely faced with the problem of physics, they just practice the application of the formula or homework tasks whose solution is already in their textbooks.

Students who do not usually face problems in physics problem will be stuck to always determine what the equation will be used first. They do not follow the steps as presented by Heller & Heler (2000), which focus the problem, describe the physics, plan a solution, execute the plan, and evaluate the answer. Most students eventually get used to the order of what is known, what is asked and directly on what the equation. Such a move is only suitable for understanding the exercise of an equation. At about the physics of the problem, the equation is not available ready-made and the quantities involved can not be used directly in this equation. So it must first be focused on what the problem, then elaborated aspects of physics. Through the translation of these equations will be seen what can be used to solve the problem. Then put-magnitude scale, after that need to be evaluated again to see if the steps are correct and consistent use. In addition, it appears that most of the students is very inefficient in solving step as a result of their focus is not the problem in advance, but instead tend to write the steps to try (trivial).

Judging from the students' ability to conclude that the higher the higher the ability of student problem solving skills. In this case, students with higher ability have a greater ability to determine the steps and equations used to solve the problem. This can be explained as the result of mastery of their more numerous and varied than the student group underneath.

Low ability solving problems caused by students because students are not familiarized with the patterns of problem solving them. During this time they were in high school teachers think that with the usual form of training they provide, students are trained in problem solving, and training (drill) does not form a problem. There are teachers who have named their teaching methods with a method of problem solving, but are given to students is the question that the answer is instant. If the method is trained properly and the problem is really a problem for students as suggested by Heller, it is expected that the ability problem solving to increase student. To implement learning with problem solving strategies, first understanding of the problems of physics teachers should be improved. Teachers should be able to distinguish the exercise or assignment with the problem.Only problem in the form of problems that can enhance students' problem solving skills. Without accustomed, then in his daily life students could not use his knowledge to solve his problems.

Furthermore, if the student answers to each question test capability Physics problem solving are analyzed further appears that most students do not know what to do. It can be inferred from the empty sheet of students' answers tc each question and the many mistakes made.

Conclusion

The conclusion of this study are as follows: 1) learning with problem solving strategies on the

topic of optics to improve the mastery of concepts, and 2) learning with problem solving strategy on the topic of optics to improve problem solving skills of students of physics teacher candidates. Increasing mastery of the concept occurred in each group, in top group with increased capacity for an average of 81.1% (high), medium group with an average increase of 67% (medium), and the lower group with an average increase of 45 , 1% (medium). While the increase in problem solving skills of students of physics teacher candidates to top the group by 73.49% (high), for the medium group 46.07% (medium) and the lower group of 36.82% (medium).

References

Galili, I & Hazan, A. (2000). "The influence of an historically oriented course on students' content knowledge in optics evaluated by means of Facets-schemes analysis". *PHY.Educ. Res., Am. J. Phys. Suppl.* 67 (7), S3-S14.

Gok, T. & Silay, I. (2008). *Effect of Problem Solving Strategies, Teaching on the Problem Solving Attitudes of Cooperative Learning Groups in Physics Education. Journal of Theory and Practice in Education* [Online], Vol 4 (2), 14 pages.
Available: http://eku.comu.edu.tr/index/4/2/tgok_isilay.pdf [June 2, 2008].

Hake, RR (1999). Analyzing Change / Gain Scores. [Online]. Available: http://lists.asu.edu/cgibin/wa?A2=ind9903&L=aera-d&P=R6855 [22 April 2008]

Heller, K., & Heller, P. (2000). *The competent problem solver for Introductory physics.* Boston: McGraw-Hill.

Heller, P., Keith, R., & Anderson, S. (1992). *"Teaching problem solving through cooperative grouping.* Part 1: Group versus individual problem solving". *American Journal of Physics, 60* (7), 627-636.

Kyurshunov, A. (2005). *Problem solving in Science Education.* Discussed from the Russian perspective, with special focus on physics. Karelian State Pedagogical University, Russia.

McMilan, JH & Schumacher, S. (2001). *"Research and education: A conceptual introduction* (4th Ed.). New York: Longman

van Heuvelen, A. (2001). "Millikan Lecture 1999: The workplace, student minds, and physics learning systems". *Am. Jour. Phys.* (69) 11, November 2001, pp. 1139-1146.

Selçuk, GS, Çalışkan, S., & Erol, M. *(2008).* The Effects of Problem Solving Instruction on Physics Achievement, Problem Solving Performance and Strategy *Use. Lat. Am. J. Phys. Educ.* [Online], Vol 2 *(3).* Available: www.journal.lapen.org.mx/sep08/LAJPE_191_Selcuk_F.pdf. [2 January 2009].

Yap, KC & Wong, CL (2007). Assessing conceptual learning from quantitative problem solving of a plane mirror problem. *Physics Education.* 42 *(1),* 50-55.

Yousuf, MA & Chaveznava, RM (2006). *Physics Problem Solving Using Variable Flow Diagram.* [On Line] Available at:http://icee2008hungary/download/fullp/full_papers/full_paper476.pdf . [January 2, 2009].

Certificate

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Drs. Eko Swistoro, M.Pd

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