

Effects of Problem-Solving Strategy on Secondary School Physics Students' Attitude and Academic Achievement in Jos North L.G.A., Plateau State, Nigeria

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Abstract. This study examined Effects of Problem Solving Strategy (PSS) on Secondary School Physics Students' Academic Achievement in Physics in Jos North Local Government Area, Plateau State, Nigeria. A true experimental research design was used in the study. Two senior secondary schools of co-educational standards in Jos North Educational Zone Plateau State were selected from which 60 physics students were also sampled. Randomly, the students were assigned to the experimental (n=30) and control (n=30) groups. Using PSS, the experimental group was taught the concepts Work Energy and Power (WEP) and Elasticity while the conventional lecture approach was used to teach the same concepts to the control group. The Physics Students' Problem Solving Achievement Test (PSPSAT) and Physics Students' Problem Solving Attitude Rating Scale (PSPSARS) were developed by the researcher with reliability coefficients of 0.85 and 0.74 respectively. The PSPSAT was used to determine the level of achievement of students taught using the PSS and their counterparts taught using conventional lecture method. On the other hand, the PSPSARS was used to determine the attitude of students towards problem solving. The content validity of these instruments was established by three experts. Employing SPSS version 22 software, data analysis was carried out using t-test for the PSPSAT and mean analysis for the PSPSARS.

The findings of this study showed that the performance levels of both male and female students after treatment improved significantly though male students achieved slightly higher than their female counterparts after exposure to PSS. The results further showed that students taught using PSS performed significantly better than their counterparts taught with conventional lecture approach. Furthermore, the result revealed that students in private schools performed better than the students in public schools after exposure to PSS. The study concluded that the use of PSS promotes students' understanding of concepts translating to optimal performance in physics examinations. It was recommended among others that authors and textbook writers of physics textbooks should transform physics textbooks into problem solving forms, apply and provide proper illustrations so as to meet the criteria of PSS as doing this would help in enhancing students' achievement in physics.

Keywords: Physics, Problem-solving Strategy, Attitude and Academic Achievement.

1. Introduction

One of the most important targets of modern education is to instill in learners the ability to solve problems. A physics classroom takes no exception to this considering the fact that

physics is regarded as the bedrock of scientific and technological development worldwide in both developed and developing countries alike (Adeyemo, 2010). Physics is one of the essential parts of the Nigerian secondary school curriculum. Thus, at the senior secondary school level in Nigeria, physics has been identified as one of the core science courses as stated in the National Policy on Education (FRN, 2004). It plays a fundamental role in scientific progress and development. These roles are in everyday applications in most social sciences, engineering, biological sciences, medicine, military, aerodynamics and so on (Mwelese & Wanjala, 2014).

The Nigerian government in recognition of the importance of science and technology, especially physics has taken a number of steps towards its improvement. These steps included the implementation of the Science and Technology Education Post Basic project with support from the World Bank which focuses on the production of adequate and quality science and technology graduates. Furthermore, the inclusion of Physics in Technology in the recently reviewed Senior Secondary School Physics Curriculum was a significant step towards the improvement of science and technology in Nigeria (Mankilik & Umaru, 2015). Despite the efforts of the Nigerian government, researchers generally observed students' low enrolment and poor performance in physics (Mankilik & Umaru, 2011; Erinsho, 2013; Aina & Olanipekun, 2014). The students' low enrolment and poor performance in physics is indicative of a serious variance between the expectations of the Nigerian Government as spelt out in the National Policy on Education (NPE) and the actual situation of physics in our schools and this calls for a review of the strategies teachers adopt in the teaching and learning of physics (WAEC, 2008).

In agreement with the low enrolment of students in physics, the analysis of the West African Examinations Council (WAEC) results shows that on the average between 2006 and 2014 in Nigeria, about 35% of the total number of students that registered for West African Senior School Certificate Examinations (WASSCE)

entered for physics. In terms of performance, the WAEC Chief Examiner's reports (2005-2013) in physics indicated poor performance of students generally despite the favourable standards of the paper and the moderate severity of the marking scheme. In line with this, the analysis of the WAEC and National Examinations Council (NECO) results of candidates' performance in physics for the May/June 2006-2013 SSCE in Nigeria indicated general poor performance. Also, in 2013, for WAEC, the case is even worse as 0.05% of the 38,738 candidates that sat for physics in Plateau State had distinction. It is to be noted that a performance level of less than 1% pass with distinction is grossly inadequate for Nigeria's quest for rapid scientific and technological development (Mankilik & Umaru, 2015).

The following reasons have been identified for poor performance of students in physics: inadequate qualified physics teachers, abstract nature of physics concepts, poor mathematical background, method of teaching, lack of problem-solving skills, and students' attitude. Research undertaken in different areas of physics showed that methods of teaching and problem solving skills are major factors to be considered for better performance in the subject (Orji, 2000; Brewton, 2001; Gonzuk & Chagok 2001).

Several studies on gender issues in physics education noted differing views. Some people even believed that males performed better than females in any course that deal with calculation as observed by Awoniyi (2000) that male candidates performed better, relative to females in subjects requiring quantitative ability. He said males show superiority in science, statistics and accounting. Gender has been identified as having significant effect on students' performance in physics at the secondary school level (Onah & Ugwu, 2010). Another study indicated that gender is not a strong determinant of students' academic achievement in physics rather the teaching approaches adopted which should not discriminate between the sexes (Akinbobola & Afolabi, 2010). Consequently, the active learning strategies for instruction could be structured to eliminate any undue effect

of gender on student's performance (Mankilik & Umaru, 2015).

Furthermore, some researches in school type (public and private) showed conflicting views. For example, in a study conducted by Olatoye and Agbatogun (2009), students from public schools lagged behind in their performance in the sciences when they were compared with those in private schools. On the contrary, in another study conducted by Lubianski and Lubianski (2006), students in regular public schools performed as well as students in private schools when presented with equal learning opportunities. It is therefore of importance that the effect of school type be properly investigated and addressed. Students' attitude towards problem solving in physics is also an issue that has been under investigation by researchers (Erdemir & Bakarci, 2009). Students come to class with the mindset that the physics concept or discipline as a whole is difficult or impossible to understand and pass so they resort to missing physics classes and not studying. Consequently, the good ones among the students show that they have interest in physics lecture and thereby developing positive attitude toward solving physics problems.

Some researchers opine that attitude matters a lot when it comes to performance in physics while others argue that poor performance of students in physics was due to lack of information, lack of self-confidence, inability to solve physics questions correctly using the appropriate formula and not being able to see the relevance of physics to the society not necessarily their attitude (Olusola, Olasimbo & Rotimi, 2012).

It is important to understand the concept of problem solving as a strategy in the Physics classroom. A problem generally is believed to be a hitch between where one is and where one wants to be. In physics, the problem that is yet to be solved could be in question or exercise form. The term problem solving is used in many disciplines, sometimes with different perspectives and often with different terminologies. Problem solving consists of using generic or adhoc methods in an orderly manner for finding solutions to problems.

It is important to understand that problems generally can be classified into two types: ill-defined and well defined problems. Ill-defined problems are those that do not have clear goals, solution paths or expected solutions while well-defined problems have specific goals, clearly defined solution paths and clear expected solutions. It is important that a physics problem is well defined so as to achieve the goals for which the problem is posed. Some of these problems may be fundamental to future problems students or learners may encounter in physics since learning is from simple to complex, known to unknown, concrete to abstract and so on. When such problems are solved by a learner, attitude towards physics may become positive and learner's interest is sustained. Thus, the exposure of problem solving strategies that students receive can help them improve their achievement, increase their interest in physics and change students' attitude towards learning physics (Gok, 2010).

According to Schoenfeld (1994), problem solving is a complex process that engages various cognitive operations such as collecting and sorting information, heuristics and metacognitive strategies. The ability to understand what the goal of the problem is and what roles will be applied will present the key to solving the problem because sometimes the problem to be solved involve some abstract thinking and coming up with a creative strategy.

Considered the most complex of all intellectual functions, problem solving has been defined as a higher order cognitive process that requires the modulation and control of fundamental skills. Hence, problem solving are the steps that one will take to achieve one's own goals. Most students are not actually weak in solving problems, but rather unskilled in planning strategies when solving a given problem (Schoenfeld & Zan, 2000).

Problem solving strategy is a method that can potentially produce effective and meaningful teaching and learning. The application of this strategy in teaching and learning can help improve students' problem solving skills as

problem solving is a basic skill needed by all students (physics students alike), but at the same time can also be a complex mental activity (Charles, 1997). The implementation of problem solving in the teaching and learning environment can improve the quality of learning. Through these strategies, physics students have to find information and solve problems through their own efforts; this process compels them to be independent and to think creatively. Problem solving is known as one of the essence in building future engineers and technologists (Jonessen, 2006). They are people who make our life easier, healthier and safer through new designs and technologies whose backdrops are rooted in physics.

According to Ruhizan, Lilia and Azaman (2012) research conducted found that students fail in solving problems due to a few factors, that is, low understanding of the given problem, low knowledge of how to plan an appropriate problem solving strategy, inability to interpret a problem, application of inappropriate strategy and poor understanding of concepts. Problem solving is a cognitive process that requires the memory to collect the appropriate activities, employ them and work systematically.

As a staged process, problem solving was brought up by a Hungarian mathematician, George Polya, for the first time in his book "how to solve it" published in 1945. This staged process that was widely accepted in problem solving is the first and most popular model. The staged model consists of simplified lists of stages or steps used in problem solving. Each stage leads to the next stage and is as a result of the previous stage. These four stages include-understanding the problem, planning, application of the plan and looking back. These skills can be seen as the analytical parts of problem solving process which requires defining the problem, examining the problem, revising and employing it.

Problem solving is the core of learning in physics. Personal classroom experience with secondary school students in Nigeria and results of private and public examinations show that most learners are yet to acquire the vital problem solving skills required for success

(Adeleke,2007). The inappropriate utilization of relevant teaching and problem solving strategies has been major concerns of physics educators. Specifically the defective methodology employed by the teachers, as well as the non-use of appropriate problem solving strategies generally lead to students' low enrolment and poor performance in physics (Adegoke, 2011). This implies that the way learning materials are presented to the students manifests in their non-active participation in learning, lack of interest and proper understanding of physics. Again, lots of students complain that despite the time and energy put into learning physics, they still find it difficult to solve problems in physics. This is not because they lack an understanding of the physics concepts though; they just lack the ability, skill and strategy to solve these problems. Therefore there is need to consider remedial methods of teaching and learning that will improve problem solving skills quite different from conventional ones. Moreover, the researcher could not lay hands on any research work carried out on this issue within the designated area. This may be because not much research has been carried out in the area of problem solving in physics in the study area. Therefore the researcher was motivated to carry out this study which examined the use of problem solving strategy with a view to providing means of rectifying identified deficiencies. The problem of the study is posed as the question- What is the effect of problem solving strategy on physics students' achievement in the subject?

2. Purpose of the Study

The general purpose of this study was to investigate the effects of problem solving strategy on secondary school physics students' attitude and achievement in Physics in Jos North Local Government Area, Plateau state, Nigeria. The specific objectives of this study were to:

(i) determine if there was any significant difference between the level of achievement of students taught using problem solving strategy and those taught using the conventional lecture method.

- (ii) determine the attitudes of students towards physics problems when taught using problem solving strategies.
- (iii) find out the influence of gender on students' achievement in Physics when taught using problem solving strategy.

3. Research Questions

The following research questions guided the study:

- (a) What is the level of achievement of SS1 physics students before and after exposure to problem solving strategy?
- (b) To what extent does gender affect students' achievement in physics when taught using problem solving strategy?
- (c) What is the attitude of Physics students towards problem solving in Physics?

4. Hypotheses

- (i) There is no significant difference between physics mean achievement scores of students taught using problem solving strategy and those taught using the conventional lecture method.
- (ii) There is no significant difference between the post-test mean achievement scores of male and female students who were taught using problem solving strategy.
- (iii) There is no significant difference between the post-test mean achievement scores of students in public schools and their counterparts in private schools exposed to problem solving strategy?

5. Methodology

This study adopted the true experimental research design specifically the pretest-posttest control group design. In the pretest-posttest control group design, two groups are drawn from the sample population and the assignment of subjects to groups is by randomization. Randomization implies that all subjects have equal chance of being assigned to either the experimental or control group so there is little or no room for bias. One of the groups (experimental) was exposed to treatment and the other group (control) were not exposed to

treatment. A pretest was given to both groups before any treatment was administered so as to determine students' entry behaviour. After treatment had been administered, a posttest was then given to both groups. The aim of this design is to compare the scores of the two groups. The population of the study comprised of all physics students in SS1 in Jos North Local Government Area (LGA), Plateau State. The total number of senior secondary school students offering physics in SS1 in Jos North LGA Plateau State at the time of the study was 13,104. This population was chosen because the researchers believes that the proximity of the population will enhance quick access to data collection. The sample of the study was assumed to have the same entry behaviour because they were taught and examined by some teachers at the same level. The sample for the study was drawn from two senior secondary schools one of which is Federal Government owned and the other privately owned. The two schools were chosen because they are of the same standard in terms of facilities and teachers' quality. The sample size was sixty students which comprised of thirty males and thirty females selected from both schools equally. The sample of the study was further divided into two groups, the experimental and control groups. Each group was made up of thirty students comprising of fifteen males and fifteen females. In order to ensure that the sample of this study was reflective of the population, the procedure for sampling each group was the simple random sampling technique specifically the lottery method. For the purpose of this study, the researcher wrote YES on 30 pieces of paper and NO on 30 separate pieces of paper. The papers were folded afterwards; the folded pieces were bagged and thoroughly shuffled. The students were then allowed to pick from the bag, one student per piece. Students that picked YES constituted the experimental group and NO the control group. Two instruments were used for data collection in the study. They are Physics Students Problem Solving Achievement Test (PSPSAT) and the Physics Students Problem Solving Attitude Rating Scale (PSPSARS). The PSPSAT was divided into two sections (A and B). Section A selected, information on students' biodata (Gender and school type) while section

B was further divided into two parts (1 and 2). Part one comprised of 25 objective test items and each question had four options lettered A to D. Part two comprised of five essay test items. The objective and essay test items were drawn from the concepts Work Energy and Power (WEP) and Elasticity. There were thirty questions in all and a total of one hundred marks was allocated (that is, two marks for each objective question and ten marks for each essay question). The PSPSARS was also divided into two sections (A and B). Section A contained information on students' biodata (gender and school type) and section B contained twenty items on attitude of students towards problem solving. The students' responses on PSPSARS instrument were measured using the Lickert's five point rating scale. The terms of the PSPSAT were carefully selected by the researcher from past question papers of standard examination bodies (JAMB and WAEC). The PSPSAT and PSPSARS were further validated by an expert in the department of Science and Technology Education in University of Jos and an expert in the field of Test, Measurement and Evaluation in the department of educational foundations, University of Jos. The PSPSARS was also validated by an expert in Educational Psychology in University of Jos. The inputs and suggestions given by the experts were strictly adhered to before the production of final instrument for administration. A pilot study was carried out in Jos South LGA Plateau State and

the pretest scores obtained were used to calculate the reliability of the instrument. The internal consistency of the PSPSAT and PSPSARS were determined using Cronbach alpha. It revealed the extent to which questions and statements in the PSPSAT and PSPSARS are consistent in their measurement of students' achievement in physics problem solving and attitude towards physics problem solving respectively when taught the concepts WEP and Elasticity. The average internal consistency of the PSPSAT and PSPSARS was found to be 0.85 and 0.74 respectively. According to Awotunde and Ugodulunwa (2004), these reliability estimates are good enough for research purposes.

6. Results

Data collected for this study were presented and analyzed based on the research questions and hypotheses for the study. For the Physics Students' Problem solving Attitude Rating Scale (PSPSARS), a standard was set at a mean score of 3.0. A calculated mean score for each statement was computed. For a mean score greater than 3.0, the statement indicates a positive response while the mean score less than 3.0 was considered unfavourable according to the scale computed for the items in the PSPSARS. The analysis is presented and discussed in the tables given below:

Research Question One: What is the level of achievement of SSS1 physics students before and after exposure to problem solving strategy (PSS)?

Table 1: Level of Achievement of Physics Students Before and After Exposure to PSS

Achievement Level	Range Score	Before Exposure		After Exposure	
		No	%	No	%
High	70 – 100	1	3.33	9	30
Average	50 – 69	10	33.33	15	50
Low	0 – 49	19	63.22	6	20
Total		30	100.00	30	100

The analysis in table 1 was used to answer this research question. It showed that before exposure to PSS, the general achievement level of students was low since only one person representing about 3.33% of the group scored above 70% (so, a high achiever). 10 people representing 33.33% were average achievers and a large percentage (66%) with 19 students were low achievers. After exposure to PSS, 9 students representing 30% of the students moved to high achievement level, while 15 students representing 50%

were at average achievement level and only 6 students remained at low achievement level. This analysis indicates that the level of achievement of students taught using PSS significantly increased generally after exposure to PSS.

Research Question Two: To what extent does gender affect students' achievement in physics when taught using PSS?

Table 2: Mean Score Analysis of Male and Female Students Taught using PSS

Gender	N	N	Mean Difference
Male	15	70.33	0.86
Female	15	69.47	

The analysis in table 2 shows that the mean achievement scores of male students taught using PSS was 70.33 and that of females was 69.47. A mean difference of 0.86 was established between the male and female scores. This, by implication, means that male students achieved slightly more than their female counterparts when they were exposed to PSS.

Research Question Three: What is the attitude of students towards problem solving in physics?

Table 3: Mean Analysis of Students' Responses to PSPSARS.

S/N	Items	SA 5	A 4	U 3	D 2	SD 1	Total	X	Remarks
1.	I feel confident in my ability to solve physics problems	9	33	9	7	2	220	3.67	Accepted
2.	Solving physics problems is a great pleasure for me.	12	22	16	6	4	212	3.53	Accepted
3.	I only solve physics problems to get through the course.	8	17	2	23	10	170	2.83	Rejected
4.	I feel anxious when I am asked to solve physics problems.	7	21	15	9	8	190	3.16	Accepted
5.	I often fear unexpected physics problems.	15	29	9	4	3	229	3.81	Accepted
6.	I feel the most important thing in physics is to get correct answers.	11	11	10	24	4	181	3.02	Accepted
7.	I am willing to try a different approach when my attempt fails.	16	38	4	1	1	247	4.12	Accepted
8.	I give up fairly easily when the physics problem is difficult.	9	12	11	20	8	174	2.90	Rejected
9.	I believe I am good at solving physics problems.	13	22	17	7	1	219	3.65	Accepted
10.	Physics problems are important in everyday life.	24	20	7	5	4	242	4.03	Accepted
11.	Physics problems do not scare me at all.	4	12	25	11	8	173	2.88	Rejected
12.	The challenge of physics problems appeals to me.	10	28	14	6	2	218	3.63	Accepted
13.	I would prefer to solve problems in physics than to write an essay.	23	12	10	6	9	214	3.56	Accepted
14.	Physics problems are dull and boring.	4	4	8	24	20	108	1.80	Rejected
15.	I feel a great deal of satisfaction out of solving a physics problem.	32	22	1	3	2	259	4.32	Accepted

The analysis in table 3 revealed that students have accepted items 1, 2, 3, 7, 8, 9,10,12,13, 14 and 15 with means 3.67, 3.53, 2.83, 4.12, 2.90, 3.65, 4.03, 3.63, 3.56, 1.80, and 4.32 respectively and rejected items 4, 5, 6 and 11 with means 3.16, 3.81, 3.02 and 2.88 respectively. This means that students have a positive attitude towards problem solving in physics since out of 15 items on the questionnaire, only 4 were rejected by the physics students.

Hypothesis one: There is no significant difference between physics mean achievement scores of students taught using PSS and those taught using conventional lecture method.

Table 4: t-test showing Posttest Mean Analysis of Students’ Responses Based on Problem Solving Strategy

Group	N	X	SD	t-cal	df	P(2-tailed)	Decision
Experimental	30	69.90	10.24	4.12	58	0	Rejected
Control	30	59.60	9.10				

P<0.05

From the analysis in table 4, t-cal. was 4.12 at df = 58 and $\alpha= 0.05$. Since the t-cal. value of 4.12 is greater than the p value of 0.00, then there is sufficient evidence to reject this null hypothesis and accept the alternative hypothesis which states that there is a significant difference between physics mean achievement scores of students taught using problem solving strategy compared to those taught using the conventional lecture method.

Hypothesis Two: There is no significant difference between the physics posttest mean achievement scores of male and female students taught using PSS.

Table 5: t-test showing Posttest Mean Analysis of Students’ Responses Based on Problem Solving Strategy

Group	N	X	SD	t-cal.	df	P(2-tailed)	Decision
Experimental	15	70.33	9.86	0.23	28	0.82	Retained
Control	15	69.47	10.94				

P>0.05

From the analysis in table 5, t-cal. was 0.23, at df= 28 and $\alpha= 0.05$. Since the t-cal. value of 0.23 is less than the p value 0.82, the null hypothesis is retained. Therefore there is no significant difference between the physics mean achievement scores of male and female students taught using PSS.

Hypothesis Three: There is no significant difference between the posttest physics mean achievement scores of students in public schools and their counterparts in private schools exposed to PSS.

Table 6: t-test Showing Posttest Mean Analysis of Students’ Responses Based on Problem Solving Strategy

Group	N	X	SD	t-cal.	df	P(2-tailed)	Decision
Experimental	15	63.07	6.62	-4.89	28	0.00	Rejected
Control	15	76.73	8.57				

P<0.05

From the analysis in table 6, the value for t-cal is -4.89 and $df= 28$ at $\alpha= 0.05$. The t-cal. is less than the p value of 0.00. Thus, there is sufficient evidence to reject the null hypothesis and accept the alternative hypothesis which states that there is a significant difference between the posttest physics mean achievement scores of students in public schools and their counterparts in private schools exposed to PSS.

7. Discussion and Interpretation of Results

Research question one and research hypothesis one attempted to ascertain the level of achievement of SSS 1 physics students before and after exposure to PSS. The findings indicated that after exposure to PSS, students achieved more as evident in the significant increase in the percentage of high and average achievers and a consequent decrease in the number of low achievers as compared with the scores before exposure to PSS. This finding is in consonance with the findings of Gok and Silay (2010); Omiwale (2011) and Abubakar and Danjuma (2012) who all found that PSS is effective in the teaching and learning of physics and enhance students' achievement in physics.

Research question two and hypothesis two attempted to determine the influence of gender on students' achievement when taught using PSS. The findings revealed that though the performance of both male and female students improved in physics problem solving, their achievement was considerably the same. The mean scores for both male and female students did not significantly differ. This finding is in disagreement with the findings of Apata (2011) who found that male students were academically superior to their female counterparts in sciences. Anagbogu and Ezehora (2007) also found that female students performed better than their male counterparts in science subjects such as physics. The findings of other researchers such as Salman (2000), Aiyedun (2004) and Abdullahi (2013) are in consonance with the findings of this study which have revealed little or no gender difference in achievement of male and female students in physics.

Research question three attempted to determine the attitude of students towards problem solving. The findings of this study revealed that students have a positive attitude towards problem solving in physics. This is supported by the analysis in table 6 which indicates that most statements were accepted and very few were rejected by students. This finding is in line with the findings of Gok and Silay (2008) who had worked on a similar and study found that students have positive attitude towards physics. Also, Erdemir (2009) in agreement concludes that the usage of PSS is more useful in improving the attitude of students towards physics.

Hypothesis three testing proved that there was a significant difference between the posttest physics achievement mean scores of students in public schools and their counterparts in private schools exposed to PSS. Students in private schools performed better and achieved more than those in public schools after being exposed to PSS. This is in agreement with the findings of Kayode and Ademola (2014) that students in private schools perform better than their counterparts in public schools when taught using PSS.

8. Conclusion

The study concluded that Students taught using PSS achieved more than those taught through the conventional lecture method of teaching. This by implication means that the use of PSS in teaching improves students' achievement in physics. Students have a positive attitude towards problem solving in physics. This means that the use of PSS in teaching is enjoyable to students and that is why their attitude is positive. The findings of this study revealed that gender did not affect students' achievement significantly when taught using PSS.

9. Recommendations

Based on the findings of this study, the following recommendations have been put forward:

(i) Authors and textbook writers of physics textbooks should transform physics textbooks into problem solving forms, apply and provide

proper illustrations so as to meet the criteria of problem solving strategies.

(ii) Extensive and result-oriented training programs, seminars and workshops on PSS should be organized by physics associations, examination bodies, and delegates of education for physics teachers to equip them with new strategies for solving physics problems in all topics in physics.

(iii) Problem solving strategies and courses intended to instruct these strategies should be added to the curriculum of institutions which train teachers such as colleges of education and faculties of education as doing that would help in producing trained teachers that are equipped with PSS.

(iv) More time should be allocated to physics lessons so that more strategies can be explored in the classroom. When little time is given to lessons, teachers rush through instructions so promote the conventional lecture method rather than take time to follow the lesson step by step with the appropriate strategy.

(v) Physics teachers should be encouraged to use problem solving method to develop students' problem solving skills and the related outcomes such as course achievement.

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