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CREATING AND SUSTAINING ACTION LEARNING IN PHYSICS CLASSROOM

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Abstract

The study was conducted to find out the effect of action learning strategy on students' academic achievement in Nigerian senior secondary school physics. A criterion sampling technique was used to select the sample schools. A total of 280 students took part in the study. A Physics Achievement Test (PAT) with coefficient of internal consistency of 0.82 using Kuder Richardson formula 21was the instrument used to collect the data. The result showed that action learning strategy enhances students' achievement in physics more than problem-based learning strategy. Also, gender has no significant effect on the achievement of physics students taught with action learning and problem-based learning strategies. When students are allowed to discover problems and work together cooperatively in a small group to find solutions to them through join intellectual effort; resourcefulness, innovation, creativity, student - centeredness, respect for other people's view, problem solving skills, initiative, curiosity and critical thinking can be created, developed and sustained in physics classroom.

Keywords: *Action Learning, Problem-Based Learning, Achievement, Physics.*

Introduction

Science has played a dominant role in the developmental efforts of nations. It has been identified as a potential instrument for solving socio-economic problem such as unemployment, hunger, poverty, population explosion and environmental degradation, which are problems facing developing nations like Nigeria (Afolabi & Akinbobola, 2009). However, Nigeria has been making frantic efforts with a view to create scientific and technological awareness in her citizenry (Afolabi, 2009). Thus, the major aim of teaching science in schools is to facilitate students' acquisition of science process skills and to promote the understanding of the concept being taught with a view to applying it to real life situation. Therefore, an average science teacher in a classroom in Nigeria is confronted with the problem of using appropriate instructional strategies to disseminate idea to his students and how to make curriculum more relevant to the lives and experiences of the learner which are serious hindrances for effective teaching and learning of science (Akinbobola, 2009).

According to Akinbobola (2006), the selection of the appropriate and most effective strategies of instruction is very important to the success of any lesson. In Nigeria, Akinbobola (2008) affirmed that the changes in the aims and objectives of physics curriculum have not been accompanied by corresponding changes in the teachers' educational practices. A critical look at the contents of physics curriculum in Nigeria indicate that the traditional teacher-centered approaches are not relevant and appropriate to promote efficient learning of the content of the programme. However, there is a need for strategies that will not only maximize meaningful understanding of concepts in physics but would provide students the opportunity to interact with their environment and also students and their teachers to clarify their misconceptions. Examples of such strategies include action learning and problem-based learning strategies.

Action learning is an educational process whereby the participant studies their own actions and experience in order to improve performance (Kramer, 2007). This is done in conjunction with others, in small groups called action learning sets. It is proposed as particularly suitable for all learners, as it enables each person to reflect on and review the action they have taken and the learning points arising, this should then guide future action and improves performance. Weinstein (1995) defined action learning as a process of underpinning a belief in individual potential and a way of learning from their actions and from what happens to them and around them by taking the time to question, understand and reflect, to gain insights and consider how to act in future.

Marsick (1987) supported that action learning sets creates the environment which can enable participants to critically reflect on their own personal development which is in line with the physics curriculum objectives. Marquardt (2004) described action learning as a strategy which prepares to explore peoples' area of ignorance with suitable questions. Robinson (2001) discovered that principles and practices of action leaning have helped in developing students' involvement in learning, reflection and autonomy.

According to O'Hara, Bourner and Webber (2004), action learning sets collectively based on the premise that participants are willing to share, whereas traditional learning based on individualistic approach. Therefore, action learning set can be a powerful vehicle for introducing students to collaborative learning, tapping into knowledge and learning together through shared experience. Action learning strategy increases employees learning capacity within an organization while responding to a real world challenge in a cross-departmental team. What exactly is action learning? Mumford (1994) described it as a dynamic process that involves a small group of people solving real problems, while at the same time focusing on what they are learning and how their learning can benefit each group member, the group itself and the organization as a whole. Perhaps action learning’s most valuable capacity is its amazing, multiplying impact to equip individuals, especially leaders, to more effectively respond to change. Learning is what makes action learning strategic rather than tactical. Fresh thinking and new learning are needed if we are to avoid responding to today’s problems with yesterday’s solutions while tomorrow’s challenges engulf us.

The principles of action learning sets as outlined by Smith and O’Neil (2003) include the following:

- Participants bring a problem to the set
- Participants meet in small groups called ‘set’.
- Participants meet regularly usually over a fixed period of time
- Problems are relevant to each person.
- A supportive sharing learning environment is created within the set sometimes with the aid of a facilitator in the early stages.
- The process includes questioning, reflection, discussion and debate.
- Participants carry out action between set meetings.

Action learning is a learning by doing in which small group of people come together to identify a problem, develop an action plan to solve the problem, meet regular for the implementation, and learn from the implementation in an attempt to change things.

Revans (1983) used the equation L = P + Q to illustrate the process of action learning, where learning (L) is acquired through programmed knowledge (P) otherwise known as traditional method or formal instruction and questioning (Q) to generate insight and full exploration of unknown so that it becomes known. The Q uses four “major” questions: what? Who? When? Where? and 3 “minor” questions: how much? How many? Why?

Maloney (1994) defined problem based learning as a strategy that consist of carefully selected and designed problems that demand from the learner acquisition of critical knowledge, problem solving proficiency, self-directed learning strategies and team participation skills. It reduces teacher’s instruction where learners are seen as active listeners and passively involved in classroom activities as in the case of conventional method. Problem based learning is an example of constructivist learning strategy which poses significant contextualized real world situations and providing resources, guidance, and instruction to learning as they develop content knowledge and problem solving skills (Yager, 1991).

According to Merrill (2007), problem-based learning is organized with small cooperative groups of learners accompanied by a teacher, instructor or facilitator. During this process, a series of problems (starting with introductory problems) with guidance from the teacher, instructor or facilitator are provided to learners, and then later guidance is faded as learners gain expertise. Guidance reduces as group members fed more confident with the subject matter and become more competent with learned procedures. In problem-based learning, students have to start with introductory problems with worked examples and later increases progressively with level of difficulty. That is, students should start from simple problems (known) to complex problems (unknown).

In problem-based learning, the teacher starts by guiding the students to identify the problems and help them to link tasks with previous knowledge. Thereafter, the students discuss the problems cooperatively among themselves in a small group, explain what they know, pose research questions, generate hypotheses, develop initial plans and organize their knowledge, attempt to solve the problems with several modifications, derive learning goals and organize further work. Finally, the results are presented to larger groups through the guidance of the teacher, instructor or facilitator and the students are allowed to reflect on the learning that has taken place. Problem-based learning is also a form of inquiry based learning which explains the environment in which learning is driven by a process of inquiry constructed by the students.

Twomey-Fosnot (1989) defines problem-based learning by reference to four principles: Learning, in an important way, depends on what already know; new ideas occur as we adapt and change our old ideas; learning involves inventing ideas rather than mechanically accumulating facts; meaningful learning occurs through rethinking old ideas and coming to new conclusions about new ideas which conflict with our old ideas. A productive, problem-based learning classroom consists of learner-centered with active instruction. In such a classroom, the teacher provides students with experiences that allow them to hypothesize, predict, manipulate objects, pose questions, research, investigate, imagine, make inquiry, reflect, interact and invent. The teacher's role is to facilitate this process. Hence, it can be used to create learners who are autonomous, inquisitive thinkers who question, investigate and reason. The environment is democratic, the activities are interactive and the students are empowered by a teacher who operates as a facilitator or consultant (Afolabi & Akinbobola 2009). Bruner (1990) provides the following principles of problem based learning;

- Instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness)
- Instruction must be structured so that it can be easily grasped by the student (spiral organization).
- Instruction should be designed to facilitate extrapolation and or fill in the gaps (going beyond the information given).

Based on the discussion above, what then is the difference between problem-based learning and action learning? In problem-based learning, the teacher guides or fashion out the problem to the students. That is, the teacher helps the students to identify the problem while the students provide solution to the problem. In action learning, both the problem and solution are discovered by the students.

Statement of the Problem

In spite of all the advantages derived and the recognition given to physics as one of the core science courses and as a pivot to technological and economic development, there are wider gaps between curriculum planner, the implementers, that is, physics classroom teachers and what goes on in the classroom. This has led to the perception of students that physics is a difficult subject. This perception of students has affected learners' interest and led to declining rate of students' achievement in physics in West African Senior Secondary School Certificate Examination (WASSSCE) conducted by West African Examinations Council (WAEC) and National Examinations Council (NECO) in Nigeria (Akinbobola, 2008). Hence, could action learning be used to create and sustain students' interest and enhance their achievement in Physics?

Purpose of the Study

The purpose of the study is to investigate the effect of action learning strategy on students' academic achievement in physics. Specifically, the study is designed to achieve the following objectives:

1. To compare the achievement of physics students taught with action learning strategy and those with problem-based learning strategy
2. To ascertain the effects of gender on students' achievement in physics when taught using action learning and problem based learning strategies.

Research Hypotheses

Based on the purpose of this study, three hypotheses were formulated and tested at the .05 level significance.

H_o1: There is no significant difference between the academic achievement of students taught with action learning strategy and those taught with problem-based learning strategy.

H_o2: There is no significant difference between the academic achievement of male and female physics students taught with action learning strategy.

H_o3: There is no significant difference between the academic achievement of male and female physics students taught with problem-based learning strategy.

Research Method

A quasi experimental design was adopted for the study. The population for the study comprised of all 680 senior secondary two (SSII) physics students in all the eight (8) secondary schools in Obudu Local Government Area of Cross River State of Nigeria. The sample for the study was 280 registered senior secondary two (SSII) students offering physics in the four secondary schools used for the study. Criterion sampling technique was used to select the schools used for the study from the population. The criteria are:

1. Schools with standard physics laboratory with the basic materials and equipment for conducting required practicals.

2. Schools that have at least two university graduate physics teachers with five years and above teaching experience.

3. Schools that are currently presenting candidates for the Senior Secondary School Certificate Examination (SSSCE).

Six schools met the above criteria. Four schools were randomly selected from the schools that met the above criteria through the use of hat and draw-method. The four schools were randomly assigned to experimental and control groups.

The instrument used for the collection of data was Physics Achievement Test (PAT) which comprised of 50 multiple-choice item test questions drawn from the concept of waves. Each item had five options (A – E) with only one correct answer. The instrument (PAT) was validated by a physics educator and a seasoned physics teacher. To further strengthen the suitability of the instrument, the PAT was administered to a group of 30 students who did not participate in the main study, but who were found equivalent in all respect to the students used for the main study. The data obtained was analysed using Kuder Richardson formula 21 and a coefficient of internal consistency of 0.82 was obtained. The average difficulty and discrimination indices of PAT items were 0.58 and 0.52 respectively. Based on this, the instrument was found suitable for the study.

In order to ensure teachers quality variables, the research assistants (Physics teachers used in the selected schools of study) were trained for two weeks on how to use action learning strategy and problem-based learning strategy to teach the selected subjects for the study. The research assistants were given detailed instructions with well organized lesson plans on the concepts of waves. After the training of the research assistants, the PAT was administered to the two groups as pretest and the scores obtained were used to account for possible pre-existing differences in the initial ability between the two groups. After the administration of the pretest, treatments were given to the two experimental groups.

The experimental group 1 was taught the concept of waves with action learning strategy. The researchers adopted the work of Marquardt (2004). According to Marquardt, steps in action learning involve the following processes.

1. **Clarify the objective:** The objective of the action learning must be identified, following the presentation of the problem or the task to the set. A set may handle more than one problem.

2. **Group formation:** The teacher helps in the formation of the action learning sets in their intact classes. The sets are grouped based on their performances in the pre-test and each set comprises of five students of mixed ability. Action learning sets will meet twice daily to discuss the problem based on the time available for its resolution.

3. **Analyze the issue(s):** This involves identification of action learning for resolving them.

4. **Presentation of the problem**: The initiator for the problem among the set presents the problem briefly to the set and awaits the group's recommendations.

5. **Reframe the problem**: After a series of questions, the sets often with the guidance of the action learning teacher, will reach a consensus on the most critical and important problem the sets should work on. The sets establish the crux of the problem, which might differ from the original problem.

6. **Determine goals**: Once the key problem or issue has been identified, the set seeks consensus for the goal. The achievement of the goal would solve the restated problem for the long term with positive rather than negative consequences on the individual and team.

7. **Develop action strategies:** Much of the time and energy of the sets will be spent on identifying and pilot testing of possible action strategies. Like the preceding stages of action learning, strategies are developed via reflective inquiry and interaction.

8. **Take action:** Between action learning sessions, the whole sets and individual members collect information, identify the support status and implement the strategies developed and agreed to by the sets.

9. **Repeat the cycle:** Repeat the cycle of action and learning until the problem is resolved or new directions are determined.

10. **Capturing learning:** Throughout and at any point during the sessions, the action learning teacher may intervene. He will ask questions from the set members, which will enable them to clarify the problem, find ways to improve their performance as a set and identify how their learning can be applied to develop themselves and the team.

After a period of time, reconvene all the sets to discuss progress, lessons learned and next steps. They document the learning process for future reference and record the concept after each phase of learning. This process is repeated until the entire problems are solved and learning is affected.

The experimental group 2 was taught the concept of waves with problem-based learning strategy. The researchers adopted the study of Alexandria and Larson (2002). Alexandria and Larson classified the steps involve in problem-based learning as follows.

Investigation

1. **Contextualizing**: The teacher explains the process to the whole class, then works with students to help them connect the students previous experiences to the task at hand.

2. **Clarifying**: The students discuss the problem among themselves and the teacher facilitates students as they determine what they need to know in order to complete the task.

3. **Inquiring:** Students begin the process of acquiring the necessary knowledge and skills they might need to complete the task; teachers facilitate by asking questions and helping students identify and understand credible resources.

Invention and Initial Implementation

4. **Planning**: Students in each group begin to organize their knowledge and develop some initial plans as to how to approach the problem.

5. **Realizing**: Students develop a first draft or beginning product that will meet the stated criteria for the problem. Each small group will develop an original approach and no two will look exactly alike.

Further Implementation and Evaluation

6. **Testing**: The students check their problem against the criteria to see if it meets the specifications. It is expected that the first attempt will need some or several modifications.
7. **Modifying**: Students rework their problem in terms of deficiencies they may have identified. They then retest and modify until they have a finished task that meets the stated criteria.
8. **Interpreting**: Students describe the value of the problem solved relative to their backgrounds and experience.
9. **Reflecting**: Students broaden their evaluations of the problem solved and put it in larger context.
10. **Celebration**: Students present their problem solved to the larger group while the large group acknowledges the value of the effort and results of the group.

The two groups were taught the concept of waves using the same content outline for 8 weeks. The posttest was administered to the two groups after the treatment. The researchers scored the instrument immediately after its administration. Each correct answer was scored 2 marks. The maximum mark for all the fifty item questions was 100 marks. The data collected were analysed using t-test. All hypotheses were tested at the .05 level of significance.

Results:

Table 1: t-test analysis of pre-test scores of physics students taught with action learning and problem- based learning strategies.

Strategy	**N**	**$\bar{X}$**	**S.D**	**DF**	**t-cal**	**t-critical**	**Decision**
Action Learning	235	24.96	6.84	278	0.83	1.96	NS
Problem-Based Learning	245	25.63	6.62				

NS = Not significant at P<.05 alpha level

The analysis in Table 1 shows that the calculated t-value of 0.83 is less than the critical t-value of 1.96 at P<.05 alpha level. The result shows that there was no significant difference in the background knowledge of the students in the two groups used for the study. The reason for this might be due to the fact that the topics of this study were found to be relatively new to the students since they have not been taught. Any significant change in the course of the experiment would be attributed to the treatment.

Hypothesis One:

There is no significant difference between the academic achievement of students taught with action learning strategy and those taught with problem-based learning strategy. The analysis is as shown in Table 2.

Table 2: t-test analysis of post-test scores of action and problem-based learning strategies.

Strategy	**N**	**$\bar{X}$**	**S.D**	**DF**	**t-cal**	**t-critical**	**Decision**
Action learning	235	74.50	8.54	278	4.83	1.96	-
Problem-Based Learning	245	67.72	7.69				

* = Significant at P<.05 alpha level

The result in Table 2 shows that the calculated t-value of 4.83 is greater than the critical t-value of 1.96. Therefore, the null hypothesis which stated that there is no significant difference between the academic achievement of students taught with action learning strategy and those taught with problem-based learning strategy is rejected. The table also shows that physics students taught with action learning strategy achieved significantly better than those taught with problem-based learning strategy.

Hypothesis Two

There is no significant difference between the academic achievement of male and female physics students taught with action learning strategy.

The analysis is as shown in Table 3.

Table 3: t-test analysis of post-test scores of male and female physics students taught with action learning strategy.

Action learning	**N**	**$\bar{X}$**	**S.D**	**DF**	**t-cal**	**t-critical**	**Decision**
Male	114	74.90	8.89	233	0.71	1.96	NS
Female	121	74.10	8.22				

Ns = Not significant at P<05 alpha level

The result in Table 3 Show that the calculated t-value of 0.71 is less than the critical t-value of

the academic achievement of male and female physic students taught with action learning strategy is retained. This implies that male physics students are not significantly better than their female counter parts when they are taught with action learning strategy.

Hypothesis Three

There is no significant difference between the academic achievement of male and female physics students taught with problem-based learning strategy.

The analysis is shown in table 4

Table 4: t-test analysis of post-test scores of male and female physic students taught with problem-based learning

Problem based	N	$\bar{X}$	S.D	DF	t-cal	t-critical	Decision
Male	118	70.18	6.90	243	1.06	1.96	NS
Female	127	69.27	6.34				

Ns= not significant at P<05 alpha level

The result in Table 4 shows that the calculated t-value of 1.06 is less than the critical t- value of 1.96. Therefore, the null hypothesis which stated that there is no significant difference between the academic achievement of male and female physics students taught with problem based learning strategy is retained. This implies that male physics students are not significantly better than their female counterparts when they are taught with problem based strategy

Discussion

The result from Table 2 is a clear indication that action learning strategy has a significant effect on students' academic achievement in physics. This might be due to the fact that in action learning, students study their own actions and experiences in order to improve achievement. It focuses on research into action taken and as a result, knowledge emerges which lead to the improvement of skills, achievement, self-understand, self-development and systematic learning occurs which becomes self-sustaining in the long term. Also, action learning involve small groups that meet regularly to take action on critical problem using the collective experience of group members to create learning opportunities which include discussion of goals, share ideas and information, seek additional information, make decisions about the results of their findings and present it to the whole class. It enhances appropriate behavour in organizing work, asking questions, encouraging social interaction, demonstrating self management and facilitating better study habit and retention of knowledge.

This study is in agreement with the findings of Dilworth (1996) that action learning is a way to improve performance, promote learning and position groups or organizations to adapt better in turbulent times. It is also a way to develop the capabilities of individuals, groups, teams and overall organizations. The study is also in line with the findings of Mumford (1994) that action learning has the potential of offering opportunities to promote shared learning, small self supporting groups, the reinforcement of a set of value and behaviors linked to attendance and retention, and a process for reflective learning whilst providing a social network for students. Mumford states further that action learning offers an interesting perspective on the preferences people have for different learning behaviours. That is, if every member recognizes their preferences and how individual differ from one another, then it enables sets to recognize individual strengths and use the strengths to provide enthusiasm and energy which can ensure a broader more critical perspective through questioning, listening actively, feedback and reflection.

Although, physics students achieved higher in action learning (74.50%) than problem-based learning (69.72%), problem-based learning strategy can equally be used to teach various concepts in physics because the strategy exposes the students to more realities of life and tend to work as scientist and acquire knowledge by themselves in which the teacher only correct their mis-conceptions (Afolabi & Akinbobola, 2009).

Table 3 analysis showed that there is no significant difference in the academic achievement of male and female physics students taught with action learning strategy. The non-significant gender related difference in achievement could be explained on the fact that action learning emphasizes on learning by doing. The environment that the action learning creates can allow students to learn in variety of different ways. Students (males and females) carry out action on an individual basis and give the feedback to the set at their next scheduled meeting with observation, new knowledge acquisition from applying action and new in sights which are shared. This is ensured in all students without regard to gender. Hence, the boys and girls exposure to the same treatment enhanced their achievement with equal margin. This result also showed that the action learning is non-sex discriminatory especially in terms of enhancing student's achievement in physics. Therefore, it can be used for both boys and girls in physical classrooms. This result is in line with the findings of Onwioduokit, Akinbobola and Udoh (2009) that gender has no effect on the academic achievement of physics students when they are taught with good and motivating instructional strategies. The result is also in agreement with the findings of Ikitde (2008) and Afolabi (2009) that any good instructional strategy does not discriminate between sexes in science teaching and learning.

The result of the analysis in Table 4 showed that male physics students are not significantly better than female counterparts when they are taught with problem – based learning strategy. This might be due to the fact that both male and female students interact with each other freely in a set and this has led to development of the problem solving skills, increasing the depth of understanding, enhancing motivation, and generating greater involvement of both male and female students with the concept. This is in line with Akinbobola (2008) and Afolabi (2009) that if both sexes learn the same thing under the same condition, they are likely to achieve in the same way. This research study is in support of Afolabi and Akinbobola (2009) that problem-based equalizes interactions between male and female physics students.

Conclusion

In the light of the findings of this study, the researchers concluded that action learning strategy enhances students' achievement in physics more than problem-based learning strategy. Also, gender has no significant effect on the academic achievement of physics students taught with action learning and problem based learning strategies.

As used in the context of this study, the teacher guides or fashioned out the problem to the students in problem-based learning. That is, the teacher helped the students to identify the problem while the students provide solution the problem. In action learning strategy, both the problem and solution are discovered by the students. The study reveals that action learning provides a way of bringing learners together to work in a small group to solve problems. Through this joint intellectual effort; resourcefulness, innovation, creativity, student-centred activities, reflection, social interaction, construction of knowledge, respect of other people's view, problem-solving skills, initiative, curiosity and critical thinking can be created, developed and sustained in physics classrooms.

Recommendations

In view of the implications of the findings from this study, the following recommendations are made:

1. Without regard to sex difference, physics teacher should make effective use of action learning strategy in the classroom in order to enhance the achievement of their students in the subject.
2. Publishers, federal and states ministry of education should organize conferences, seminars and workshops for physics teachers to acquaint them with the use of action learning strategy in teaching various concepts in physics. Physics teachers should also be encouraged to attend in-service trainings through government sponsorship in Nigeria.
3. The use of action learning strategy should not be limited to physics as a subject, but should be incorporated in other science subjects.
4. Textbooks authors should emphasize action learning strategy as an instructional procedure that should be adopted by physics teachers for effective teaching and learning of the subject.
5. Efforts should be geared towards the provision of science equipment necessary for enhancing the new strategy (action learning) by the government of Nigeria (state and federal), philanthropist, non-government organizations, private sectors and organizations.
6. There should be a monitoring team from state and federal ministries of education to check the on-going science education programmes for flaws or breakdowns, provision of information to regulate activities and undertake corrective actions. The inspection should focus on the effectiveness of the newly introduced strategies, maintenance of equipment, improving students' achievement and quality of teaching.

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Table 1: t-test analysis of pre-test scores of physics students taught with action learning and problem- based learning strategies.

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Table 2: t-test analysis of post-test scores of action and problem-based learning strategies.

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