# Effects of Problem-Solving Teaching Strategy and Students' Gender on Academic Performance of Students in Mathematics in Senior Secondary School

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**ABSTRACT** This study investigated effects of problem-solving teaching strategy and students' gender on academic performance of students in mathematics in senior secondary school. The design for this study was a two-group Pretest-Posttest Quasi-Experimental. The population for the study was all the senior secondary class two (SS2) mathematics students in Ido–Osi Local Government Area of Ekiti State, Nigeria. The sample comprised of sixty (60) senior secondary class two students selected from two senior secondary schools in the Ido-Osi Local Government Area of Ekiti State. Three null hypotheses were formulated and tested at 0.05 level of significance to guided the study. The instrument for data collection was twenty (20) standardized objective questions tagged: 'Mathematics Achievement Test (MAT)'. The data collected were analysed using t-test statistical analysis. The findings showed that students taught using the Problem–Solving teaching strategy performed significantly better than their counterparts taught using the conventional method. Also no significant difference existed between male and female students in the experimental group. Based on the findings of the study, conclusion and recommendations were made.

***Key Words:*** Problem-solving, teaching strategy, gender and academic performance.

## *Introduction*

Knowledge of mathematics is basic to Science and Technology. Mathematics is one of the important subjects taught in all schools throughout the world due to its relevance to other subject most especially in the development of science and technology (Onoshakpokaiye, 2011). It is an integral part of life because it is needed by everyone for successful living. It is a pillar upon which scientific and technological advancement rest. Mathematics is an indispensable tool in the study of sciences, humanities and technology. Its usefulness to man activities cannot be overemphasized. Mathematical ideas have helped to make possible the revolution in electronics which has transformed the way we think and live today. This is why mathematics is occupying a pride place in all levels of education. Well-equipped mathematics laboratory presently has enormous impact on science and the society. The influence may be silent and appear hidden; it has helped our world in many ways.

According to Onoshakpokaiye (2011), the concept of teaching is better described than define because of different definitions. Various authors have defined teaching according to their own points of view, because of this; it has been very difficult to accept one as being the best. Ebenezar (2009) stated that teaching strategies that one uses will undoubtedly affect one's philosophy of teaching. Onoshakpokaiye (2011) cited Kolawole and Oluwatayo (2005) that effective teaching implies productive, purposeful, result oriented, qualitative, meaningful and realistic teaching. The essence of being an effective teacher lies on what to do to foster student learning. Mathematics teachers should therefore adopt teaching methods

that will enable the students to understand whatever concepts topic or principles being taught.

Various methods of teaching mathematics are known, such include guided discovery, Problem-Solving, discussion, expository, individualistic methods. These methods depend on various forms of teacher-student-activities through some methods are more activity oriented than others.

Problem-Solving is a systematic approach that reviews learning competencies, comprehending and composing, critical and creative thinking, these features are most important dimensions of thinking and learning in regardless of the acknowledgment of the importance of developing Problem-Solving skills; relatively little research has been conducted on the theme in the field of instructional design (Jonassen, 2004) . However, Engle (2007) opined that problem is the organization of teaching situation in such a way that the students are confronted with what they have to solve in mathematics with a certain amount to help.

In Problem-Solving teaching strategy, the role of the teacher is to describe for the students the terminal performance which constitutes the solution of the problem. Assess the students entering behavior for the concept and principles they will need to solve the problem. Teacher should verify the students' learning by requiring them to give a full demonstration of the 'problem solution'.

In the view of Asuguo (2009), Polya's heuristic approach to solving mathematics problems is becoming popular among Nigerian mathematics teachers. Many research works have been carried out in mathematics on the effectiveness of Problem-Solving method of teaching. Popoola (2002) found students who were taught mathematics concepts using Problem- Solving method to out-perform students in the conventional class. Carey (1998) conducted a corroborative study using ninety six (96) elementary psychology students to investigate sex differences in Problem-Solving performance as a function of attitudinal difference. This study showed that students who had positive attitude towards Problem-Solving solved most of the ten mathematics problems. In a closely related study,

Problem - solving is the process of investigation where the solution is not obvious to the investigator at the initial stage. The relevant concepts in the cognitive structure of the students must be adequate before the students will be able to solve a given task or problem effectively. As a teaching strategy, problem-solving entails training the students on how to solve problems by proceeding in a logical step by step manner from a problem state to its solution. It is on this premise that theorists in problem - solving have identified -'basic stages involved in the strategy (Johanning, 2006 and Smith, 1991). According to Lorenzo (2005) cited by LIoyd, William, Megan, Jacinta &George (2014), students using problem-solving heuristic were more confident at had a higher ability to solve difficult Chemistry problems.

This study also investigated gender issues in mathematics. According to Awodun (2015) gender differences have become critical issues of concern around the world most especially to educators and researchers. Hansman, Tyson and Zahidi (2009) reported that there is no country in the world that has yet reached equality between women and men in different critical areas such as in economic participation or education. In the study conducted gender issues in mathematics by Anagbogu & Ezeliora (2007) and Orabi (2007) found no significant difference between male and female students taught science concepts. Ajibade (2000), in his study, sex differences and students' academic performance in secondary schools in Ondo West L.G.A of Ondo state found that female student perform better than their male counterparts while Iwendi (2009) found male students to outperform their female counterpart.

The problem of poor achievement in mathematics is a great concern to mathematics educator and relevant stake-holders in education. Most of secondary school teachers appear to use lecture method to teach mathematics which seems not to help the students to understand the various mathematics concepts and this hindered the development of their analytical reasoning. As a

result of poor methods of teaching; most of students feels that the subject is too difficult and esoteric to understand.

**Purpose of the study**

This study is to investigate the effects of Problem-Solving teaching strategy and conventional teaching method on secondary school students' academic performance in mathematics. Also, the study is to examine the effects of Problem-Solving on gender (male and female) of students in secondary school.

**Research hypotheses**

The following null hypotheses were formulated to guide the study:

1. There is no significant difference in the achievement mean scores of students in experimental and control groups before treatment.
2. There is no significant difference in mean academic performance of the students taught mathematics with Problem-Solving teaching strategy and conventional method.
3. There is no significant difference in the mean academic performance of male and female students taught mathematics with Problem-Solving teaching strategy.

**Methodology**

The design for this study was a two-group Pretest-Posttest Quasi-Experimental. The design afforded the researcher the opportunity to collect relevant data which helped to facilitate better understanding and evaluation of the problem under study. The pre-test was used to establish the knowledge baseline of the students as well as the academic homogeneity of the two groups before the commencement of the experiment. The post-test was used to determine the levels of achievement of students within the two groups after the application of treatment.

The population of the study was made up of all senior secondary student class two SSS II in Ido-Osi Local Government Area of Ekiti State. The sample for the study constituted 60 students (30 males and 30 females) randomly selected for the study and gender was considered in the selection. The instrument used for the study was twenty (20) standardized objective questions tagged: 'Mathematics Achievement Test (MAT)' drawn from the topic (statistics) considered for the study.

The teaching covered three weeks with the control group taught using conventional method while the experimental group was taught using Problem-Solving teaching strategy. Twenty objective questions were drawn from the topic with four options (A-D). The tests (Pretest and Posttest) questions were administered to students; each of the tests were marked and scores accordingly.

The three formulated null hypotheses were tested at 0.05 level of significance. The data collected were analysed using inferential statistics of t-test analysis.

**Results and Discussion**

**Hypothesis 1**

There is no significant difference in the achievement mean scores of students in experimental and control groups before treatment.

**Table 1: t-test analysis of achievement mean scores of students in experimental and control groups before treatment**

| GROUP | N | $\bar{X}$ | SD | df | $t_{cal}$ | $t_{tab}$ | Result |
|---|---|---|---|---|---|---|---|
| **Experimental** | 30 | 35.01 | 10.22 | 58 | 0.432 | 2.000 | NS |
| **Control** | 30 | 36.21 | 11.28 | | | | |

**P > 0.05 (Result Not significant at 0.05 level), NS = Not Significant**.

As shown in table 1, when the mean score of students in the experimental and control groups before the treatments (pre-test) were statistically compared, a *t-value* ($t_{cal}$ = 0.432) with p> 0.05 alpha level was obtained, which was not significant at 0.05 level. This implies that there is no significant difference between experimental and control groups in pretest achievement mean score. Consequently, the null hypothesis which states that there is no significant difference in the achievement mean scores of students in experimental and control groups before treatment was accepted.

**Hypothesis 2**

There is no significant difference in mean academic performance of the students taught mathematics with Problem-Solving teaching strategy and conventional method.

**Table 2: t-test comparison of the post- test mean scores of students taught Problem- Solving in mathematics and those taught the conventional method**

| GROUP | N | $\bar{X}$ | SD | df | $t_{cal}$ | $t_{tab}$ | Result |
|---|---|---|---|---|---|---|---|
| **Experimental** | 30 | 86.40 | 14.87 | 58 | 8.379 | 2.000 | * |
| **Control** | 30 | 50.40 | 12.82 | | | | |

**P < 0.05 (Result significant at 0.05 level), * = Significant**.

As shown in table 2, when the mean score of students in the control and experimental groups after the treatments (posttest) were statistically compared, a *t-value* ($t_{cal}$ = 8.379) with P < 0.05 alpha level was obtained, which was significant at 0.05 level. This implies that there exists significant difference between the control and experimental groups achievement mean scores after the treatment in favour of experimental group. Consequently, the null hypothesis which states that there is no significant difference in mean academic performance of the students taught mathematics with Problem-Solving teaching strategy and conventional method was rejected. As such, the conventional method of instruction used for control group can be said to be less effective compared with Problem-Solving teaching strategy used in the experimental group.

**Hypothesis 3**

There is no significant difference in the mean academic performance of male and female students taught mathematics with Problem-Solving teaching strategy.

**Table 3: t-test comparison of post-test mean academic performance scores of male and female students taught mathematics using Problem-Solving**

| GROUP | N | $\bar{X}$ | SD | df | $t_{cal}$ | $t_{tab}$ | Result |
|---|---|---|---|---|---|---|---|
| **MALE** | 15 | 57.00 | 16.90 | 28 | 0.908 | 2.048 | NS |
| **FEMALE** | 15 | 52.00 | 13.01 | | | | |

**P > 0.05 (Result Not significant at 0.05 level), NS = Not Significant**.

As shown in table 3, when the mean score of Male and Female students in the experimental in posttest were statistically compared, a *t-value* ($t_{cal}$ = 0.908) with p> 0.05 alpha level was obtained, which was not significant at 0.05 level. This implies that there is no significant difference between academic performance of Male and Female students in experimental group achievement mean score. Consequently, the null

hypothesis which states that there is no significant difference in the mean academic performance of male and female students taught mathematics with Problem-Solving teaching strategy was accepted. In other words, gender of students has no significant influence on either the effectiveness (or otherwise) of the method of instruction applied.

**Discussion of results**

The results of hypothesis one revealed that the performance of students in both experimental and control groups in pretest were low and do not differ statistically. This finding established the homogeneity of the two groups involved in the study prior to the experiment. In other words, it could be said that the knowledge baseline for the two groups involved in the study are equal. Consequently, any significant difference recorded afterwards would not be ascribed to chance, but to the specific treatments applied.

Moreover, the results obtained in the testing of hypothesis two revealed that the achievement means scores of students in experimental and control groups were statistically different after the treatment. By implication, therefore, there is significant difference in mean academic performance of the students taught mathematics with Problem-Solving teaching strategy and conventional method. This finding agrees with the finding of Popoola (2002) who in her research found Problem- Solving method to be more potent in the teaching of mathematics for better understanding by the students than the conventional teaching method.

Finally, the result of hypothesis three showed that there is no gender effect on the achievement of male and female students taught mathematics with Problem-Solving teaching method. The results agrees with the earlier works of some researchers like Carey (1998), Iwenah (2009) Anagbogu & Ezeliora (2007) and Orabi (2007) who found no significant difference between male and female students taught mathematics concepts using Problem- Solving method. The result disagreed with the findings of Ajibade (2009), who found female students to perform better than their male counterparts.

**Conclusion**

Based on the findings of this study, it can be concluded that Problem-Solving teaching strategy is more potent in improving students' academic achievement in mathematics in secondary schools than the conventional method in presently in operation in most secondary schools in the nation. It can also be concluded that the effect of teaching strategy on secondary school mathematics was also found not to vary with gender of students. This simply implies that performance of students taught using different teaching strategies is not in any manner affected by their gender.

**Recommendations**

Based on the findings of this study, the following recommendations were made:

- Secondary school teachers who are already in service should be given adequate training through workshops, conferences and seminars to enhance and acquire better strategies of teaching mathematics.
- Schools curriculum should be overhauled to accommodate Problem-Solving and activity-orientated teaching strategies
- Student should develop a proper attitude towards Problem-Solving with a view to improving their performance in mathematics as well as making them functional to themselves and the society at large.

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**The appearance of things change according to the emotions and thus we see magic and beauty in them, while the magic and beauty really are in ourselves.**

**~ Kahlil Gibran.**