



Effect of Problem-Solving Instructional Strategy on Senior Secondary School Students' Attitude towards Mathematics in Ondo, Nigeria

M. F. Salman (University of Ilorin, P.M.B 1515, Ilorin, Nigeria)

J. O. Ayinla (University of Ilorin, P.M.B 1515, Ilorin, Nigeria., School of Junior Secondary Education, Kwara State College of Education, P.M.B 309, Oro, Nigeria)

C. O. Adeniyi (School of Junior Secondary Education, Kwara State College of Education, P.M.B 309, Oro, Nigeria)

L.O. Ogundele (School of Junior Secondary Education, Kwara State College of Education, P.M.B 309, Oro, Nigeria)

S. K. Ameen (School of Science, Kwara State College of Education, Ilorin, Nigeria)

Citation: M. F. Salman, J. O. Ayinla, C. O. Adeniyi, L.O. Ogundele, S. K. Ameen (2012) "Effect of Problem-Solving Instructional Strategy on Senior Secondary School Students' Attitude towards Mathematics in Ondo, Nigeria", International Journal of Asian Social Science, Vol. 2, No. 7, pp. 1056-1066.



Author (s)

M. F. Salman

University of Ilorin, P.M.B 1515,
Ilorin, Nigeria

E-mail: salman_mf2005@yahoo.com

J. O. Ayinla

University of Ilorin, P.M.B 1515,
Ilorin, Nigeria., School of Junior
Secondary Education, Kwara
State College of Education,
P.M.B 309, Oro, Nigeria

E-mail: ayinlajohnolorunfoba@yahoo.com

C. O. Adeniyi

School of Junior Secondary
Education, Kwara State College
of Education, P.M.B 309, Oro,
Nigeria

E-mail: comfort20082000@yahoo.com

L.O. Ogundele School of Junior
Secondary Education, Kwara
State College of Education,
P.M.B 309, Oro, Nigeria

E-mail: olaifa.ogundele@yahoo.com

S. K. Ameen

School of Science, Kwara State
College of Education, Ilorin,
Nigeria

E-mail: ameensakhadijat@ymail.com

Effect of Problem-Solving Instructional Strategy on Senior Secondary School Students' Attitude towards Mathematics in Ondo, Nigeria

Abstract

This study examined the effects of problem-solving instructional strategy on Senior Secondary School students' attitude towards Mathematics in Ondo, Nigeria. The target population for the study was Senior Secondary Two (SS II) students in Ondo, Nigeria. Purposive sampling technique was employed to select 173 SS II students for the study. A quasi-experimental, non-randomized, non-equivalent, pre-test, post-test control group involving a 2 x 3 factorial design was employed for the study. The dependent variable was students' attitude to Mathematics. The independent variables were the problem-solving instructional strategy and the scoring levels. The test scores were analyzed using mean scores, standard deviations, t-test and Analysis of variance on the two null hypotheses formulated. An alpha level of 0.05 was used to determine the significant level. Findings from this study showed that the experimental group significantly performed better in Mathematics than the control group. Based on this finding, it is recommended among others that teachers of Mathematics should adopt the use of problem-solving instructional strategy in teaching Mathematics at all levels of education.

Keywords: Attitude, Instructional Strategy, Problem Solving, Academic Performance.

JEL Codes:

Introduction

The word "attitude" could mean different thing to different people depending on the context of its utilization. This is due to its cognitive, emotional and behavioural components (Boliner & Wanke, 2002, Bednar & Levie, 1993, Kamradt & Kamradt, 1999). The English Dictionary defines attitude as: a way of thinking (cognitive) or a posture of the body (emotional) or self-confident or hostile behavior (behavioural).

The definition of attitude towards Mathematics is numerous as researchers' conception, ideas

and perspectives vary. According to a point of view, the attitude towards Mathematics could be positive or negative emotional disposition towards Mathematics (Zan & Martino; 2007). In other word, attitude towards Mathematics is multidimensional. It could be viewed from its cognitive, emotional and behavioural components. Thus, attitude of individual towards mathematics could be viewed as the emotions that one associates with Mathematics or the belief about Mathematics or behavior towards the subject which could be either positive or negative (Hart, 1989). Research reports on attitude in Mathematics education have revealed that attitude plays a crucial role

in learning Mathematics and connection between positive attitude and achievement in Mathematics is inconclusive (Zan & Martino, 2007).

Studies on modes of instruction in teaching of Mathematics especially at the secondary school level have overwhelmingly remain teachers-centered, with greater emphasis on lecturing and use of textbook rather than helping students to think critically across subject areas and applying the knowledge to real-life situations (Butty, 2001).

National Council for Teachers of Mathematics (2000) described problem solving based teaching as:

Using interesting and well-selected problems to launch mathematical lessons and engage students. In this way, new ideas, techniques and mathematical relationships emerge and become the focus of discussion. Good problems can inspire the exploration of important mathematical ideas, nurture persistence, and reinforce the need to understand and use various strategies, mathematical properties, and relationships (p. 182).

This succinct statement encompasses two decades of research and a reflection of the entire gamut of issues that are related to problem solving in Mathematics education. Even though, researchers have continued to grapple with the issues of problem solving through teaching. Research studies have also emphasized the role of the teacher in developing students' reasoning skills in problem-solving. Weber (2008) averred that to lead students to develop accurate criteria for what constitutes a good argument, the teacher must have a solid understanding of such criteria.

In the same vein, the National Policy on Education (FRN 2004) stressed the need for basic knowledge and application of Mathematics, Science and Technology, for purposeful and meaningful economic development, particularly in the modern age of technological advancement of the nation. The

policy also indicates that the teaching of problem solving in the classroom is very essential in order to prepare the students for problem-solving challenges outside the four walls of the classroom. The art of problem solving is the heart of Mathematics. Hence, Mathematics instruction should be designed to enable students appreciate Mathematics as an instrument of problem solving. Mathematics problem solving is seen as a complex process that often threatens both the teacher and the students. The only way to reduce its difficulty is by teaching it in a systematic and step-by-step manner.

This implies that for the goals of education to be achieved, problem solving skills and competencies of students in handling Mathematics problem solving must be built or enhanced right from the secondary school level by exposing them to different strategies that are in practice. Therefore this study seeks to find out the effect of teacher's instructional strategy on senior school students' attitudes towards Mathematics problems-solving in Ondo State of Nigeria.

Statement of the Problem

Attitude towards science denotes interest or feeling towards studying science. It is the students' disposition towards 'like' or 'dislike' science while attitude in science means scientific approach assumed by an individual for solving problems, assessing ideas and making decisions (Yara, 2009). Bolaji (2005) examined the influence of students' attitudes towards Mathematics and found that the teacher's method of teaching and his personality greatly accounted for the students' positive attitude towards Mathematics.

Mathematics educators are still conducting research on how to improve students' positive attitudes towards Mathematics for an improved academic performance. For instance, the National Mathematics Centre, (NMC, 2009) in Abuja attempted to revamp Mathematics teaching and learning at the Secondary School level researched into the causes and remedies for the abysmal failure of students in WAEC, SSCE and JAMB Mathematics examinations. The centre discovered that poor performance in

the promotion or public Mathematics examinations has more to do with the teacher's method of teaching than the contents of the curricular of the school Mathematics (NMC, 2009). It was against this empirical background that necessitated and spurred the Centre's Mathematics Improvement Programme project (MIP) to create a new teaching methodology to enhance students' performance in Mathematics.

To this end, this study wishes to investigate the effect of problem-solving instructional strategy on students' attitude towards teaching and learning of Mathematics in Ondo area of Ondo State, Nigeria.

Purpose of the Study

The main purpose of this study is to examine the effect of teacher's instructional strategy on senior secondary school students' attitudes towards Mathematics problem-solving.

Specifically, the study aims to determine:

- The difference in the attitude of students exposed to problem-solving instructional strategy and those in the control group.
- The difference in the attitude of students scoring ability when exposed to problem-solving instructional strategy

Research Questions

The study was designed to find answers to the following questions.

- Is there any significant difference in attitude between students exposed to problem-solving instructional strategy and those in the control group?
- Is there any difference in attitude of high, medium and low scoring students taught using problem-solving instructional strategy?

Research Hypotheses

The following research hypotheses are formulated based on the research questions raised:

HO₁: There is no significant difference in attitude of students exposed to problem-solving

instructional strategy and those exposed to conventional method of teaching

HO₂: There is no significant difference in the attitude of students scoring ability when taught using problem-solving instructional strategy.

Review of Literature

Mathematics has become so valuable that there is nothing in all human endeavour that does not require the Mathematical knowledge (Eraikhuemen & Oteze, 2008). Its application in Biology, Chemistry, Physics, Geography, Architecture, Music, Business, Industry, Politics, Sports, Banking, Law and Medicine cannot be over emphasized. Mathematics was construed as very important to the intellectual development and career choice of individual regardless of sex (Ebeh, 2000).

Mathematics was seen as a means of describing various phenomena, both in physical and economic situations using the concept of shapes, sizes, quantity and orders (Odogwu 2001). Mathematics serves as the only core or compulsory subject across the globe, there is no nation of the world where Mathematics is not been taught but the language of instruction may be differ due to the official language of each nation. Any other school subject is based on the choice of the students but Mathematics is compulsory for all. Therefore Mathematics can be viewed as the pillar of all knowledge (Ayinla, 2011).

Smith (2004) identified the importance of Mathematics for its own sake (universal language and intellectual tool-kit for abstraction, generalization and synthesis; logical reasoning; analytical problem solving - it 'trains the mind'); the knowledge of economy (science, technology, engineering, finance); and the citizen (access to labour market and general social and political inclusion). A substantial research study by Hoyles, Wolf, Molynue-Hodgson and Kent (2002) and Smith (2004) defined 'mathematical literacy' as encompassing the mathematical needs in the workplace which includes: interpretation and use of different representations of data; data-entry and monitoring; related communication skills; recognition of errors and anomalies;

knowledge of what, how, and when to calculate; use of relevant degrees of accuracy and plausibility.

The importance of Mathematics as a requirement for technological development cannot be over emphasized. The national policy on Education (FRN, 2004) Stressed that students should be well equipped to live effectively in our modern age of science and technology. To achieved this laudable aim, Mathematics as a subject was included in the core subjects to be taught in the 6-3-3-4 Education system (Now 9-3-4).

Attitude is an enduring organization of motivational, emotional, perceptual, and cognitive process with respect to some aspects of the individual's world. Attitude is characterized as a learnt implicit response that varies in intensity and tends to guide an individual's responses to an object. People have attitude toward all objects and in varying intensity, which may be positive, negative, or neutral. Crow and Crow (1999) described attitude as effective by-product of an individual's experience, that have its basis in his inner urges, acquired habits, and environmental influences. In other words, attitudes result from personal desires and group stimulation.

Attitudes are functions of what we think and what we feel. That is attitudes are the products of related beliefs and value. If one believes that his teacher is consultative, and he values consultation, you might have a favourable attitude towards the teacher. We can represent this relationship in the form of simple syllogism. For example:

If the teacher is consultative, (belief)
And consultation is good (value)
Then the teacher is good (Attitude)
Belief + value → attitude → behavior

Sarwar (2002) concluded that high academic achievers have better study habits and more positive study attitude than low academic achievers. Shah (2002) explores that teacher's attitude is one of the major factors affecting students' learning. Additional teacher's training may improve not only teacher's attitudes, but also students' performance.

Attitude formation is the most important aspect of an educational system. Its basis has to be laid right from the beginning. The process starts from the cradle. Human temperament varies over a very large range and this creates a variety of interests in life. It is because of these fundamental differences of human beings that people are cut out for a variety of jobs that world offers and which have to be done if a nation has to maintain itself and advance further (Kanckar, 1989).

Empirical Studies on Students' Attitude towards Mathematics

In Mathematics education, studies on attitude have been motivated by the belief that it plays a crucial role in learning Mathematics. Ma & Kishor (1997), after analyzing the correlation between attitudes and achievement in 113 classical studies, underline that this correlation is not statistically significant:

O' Brien and Porter (1994) in their study on the impact of a scheme of intervention projects on girls' attitudes to Physics in Ireland came up with the following findings among others that:

students in project schools were found to have similar attitudes to Physics than those in control schools,

students in the Co-educational schools tend to have more negative attitudes than those in the single – set schools,

there is relationship between the size of school and the attitudes of students to Physics. In general, the larger the school, the more negative the attitudes of students, and at the other extreme, students in small schools also have more negative attitudes.

Odunusi (1994) in assessing the attitude of some science students towards modern orientation in science found that students' attitudes to science are negative while gender and class level of the students did not significantly influence students' attitude towards science.

Corroborating these reports; Olatoye (2001) found that students' attitudes towards science

have significant direct effect on students' achievement in the subject. Onwu (1981) asserted that in spite of the recognition given to Chemistry among the science subjects. It is evident that students still show negative attitude towards the subject thereby leading to poor performance and low enrolments in the subject. Burstein (1992) in a comparative study of factors influencing Mathematics achievement found out that there is a direct link between students' attitudes towards Mathematics and students' learning outcomes. He also found that 25% in England and 26% in Norway accounted for the variation in students' attitude towards Mathematics that were due to students' gender, maternal expectation, expectation from the students' friends, and success attribution (belief about success in Mathematics).

Students' beliefs and attitudes have the potential to either facilitate or inhibit learning. Students' attitudes about the value of learning science may be considered as both an input and outcome variable because their attitudes towards the subject can be related to educational achievement in ways that enforce higher or lower performance. This means that those students who have more positive attitudes towards a subject tend to perform better in the subject.

Problem-Solving Approach

Problem-solving approach focus on teaching mathematical topics through problem-solving contexts and enquiry-oriented environments which are characterized by the teacher helping students to construct a deep understanding of mathematical ideas and processes by engaging them in doing Mathematics: creating, conjecturing, exploring, testing, and verifying (Lester, Masingila, Mau, Lambdin, Dos Santon and Raymond, 1994). Specific characteristics of a problem-solving approach include: interactions between students/students and teacher/students (Van Zoest, L., Jones, G. and Thornton, C., 1994), mathematical dialogue and consensus between students (Van Zoest et al., 1994), teachers providing just enough information to establish background/intent of the problem, and students clarifying, interpreting, and attempting to construct one or more solution processes (Cobb, P., Wood, T.

and Yackel, E., 1991), teachers accepting right/wrong answers in a non-evaluative way (Cobb et al., 1991), teachers guiding, coaching, asking insightful questions and sharing in the process of solving problems (Lester et al., 1994) and teachers knowing when it is appropriate to intervene, and when to step back and let the pupils make their own way (Lester et al., 1994).

Adeniran (2012) carried out a study on the effect of two problem-solving approaches on senior school students' performance in physics in Kwara state. The researcher compared the performance of students taught using physics specific problem-solving approach, target task approach and lecture method. The finding revealed that the post-test mean gain scores of students taught using the two problem solving approach was greater than the lecture method. Schoenfeld (1994) suggested that a good problem should be one which can be extended to lead to mathematical explorations and generalizations. He described the characteristics of mathematical thinking as valuing the processes of mathematization, abstraction and having the predilection to apply them, developing competence with the tools of the trade and using those tools in the service of the goal of understanding structure - mathematical sense-making.

As Cobb et al. (1991) suggested the purpose for engaging in problem solving is not just to solve specific problems, but to 'encourage the interiorization and reorganization of the involved schemes as a result of the activity'.

Approaching Mathematics through problem solving can create a context which simulates real life and therefore justifies the Mathematics rather than treating it as an end in itself. The National Council of Teachers of Mathematics (NCTM, 1980) recommended that problem solving be the focus of Mathematics teaching because, it encompasses skills and functions which are an important part of everyday life. Problem solving is a vehicle for students to construct, evaluate and refine their own theories about Mathematics and the theories of others. Problem solving is, however, more than a vehicle for teaching and reinforcing mathematical knowledge and helping to meet

everyday challenges. It is also a skill which can enhance logical reasoning. Individuals can no longer function optimally in society by just knowing the rules to follow to obtain a correct answer. They also need to be able to decide through a process of logical deduction what algorithm, if any, a situation requires, and sometimes need to be able to develop their own rules in a situation where an algorithm cannot be directly applied. For these reasons problem solving can be developed as a valuable skill in itself, a way of thinking, rather than just as the means to an end of finding the correct answer (NCTM, 1989).

However, professional organizations such as the National Council of Teachers of Mathematics (NCTM, 1980 and 1989) have recommended that the Mathematics curriculum should be organized around problem solving, focusing on:

- (i) developing skills and the ability to apply these skills to unfamiliar situations
- (ii) gathering, organizing, interpreting and communicating information
- (iii) formulating key questions, analyzing and conceptualizing problems, defining problems and goals, discovering patterns and similarities, seeking out appropriate data, experimenting, transferring skills and strategies to new situations
- (iv) developing curiosity, confidence and open-mindedness (NCTM, 1980, pp.2-3).

The ultimate goal of any problem-solving program is to improve students' performance at solving problems correctly. The specific goals of problem-solving in Mathematics are to:

1. Improve pupils' willingness to try problems and improve their perseverance when solving problems.
2. Improve pupils' self-concepts with respect to the abilities to solve problems.
3. Make pupils aware of the problem-solving strategies.
4. Make pupils aware of the value of approaching problems in a systematic manner.
5. Make pupils aware that many problems can be solved in more than one way.

6. Improve pupils' abilities to select appropriate solution strategies.

7. Improve pupils' abilities to implement solution strategies accurately.

8. Improve pupils' abilities to get more correct answers to problems

Methodology

Research Design

The research work is a quasi-experimental of the type pre-test, post-test, non-randomize non equivalent, Control group design involving a 2 x3 factorial. The Instructional Strategy is at two levels (experimental and the control groups), while the scoring level is at three levels (High, medium and low).

Sampling Techniques

The target population for this study was all the SS II students in Ondo town, Ondo State, Nigeria. The selected schools were assigned randomly to a group so as to avoid interaction that may occur among the groups if two or more groups are located in the same school. Intact classes were used. A total number of 173 SS 2 students were involved (The experimental group has 90 students and control group has 83 students)

Research Instrument

Basically, the instrument used for the study was a Mathematics Attitude Test (MAT) prepared by the researchers for the purpose of this research work. A stimulus instrument (instructional guide) for the teacher was also used. The MAT comprised 5 theory questions on problem-solving prepared according to the contents and the set behavioural objectives. Each question attracted 20 marks. The instrument was validated by lecturers of Mathematics Education in the Department of science education, University of Ilorin for proper scrutiny and necessary corrections. The questions were drawn from the West African School Certificate Examinations past questions assumed to be reliable.

Procedure for Data Collection

The Mathematics Attitude Test (MAT) was administered as pre-test on students in the two selected secondary schools. The senior secondary school two Mathematics teacher from the experimental school received training in the use of the problem-solving instructional strategy while the teacher for the control group did not use problem-solving instructional strategy stimulus to teach. After administering the pre-test, training teacher and providing them with necessary materials, teaching commenced and lasted for 2 weeks. At the end of the instruction, the pre-test instrument, that is MAT, were re-organized and administered as post-test to both the experimental and the control groups, thus marking the end of the experiment.

Data Analysis Techniques

The MAT scores formed the basis of data analysis. The research hypotheses 1 was tested with t-test and research hypothesis 2 was tested with Analysis of Variance (ANOVA).

Results

The data collected from the pre-test and the post test for both the experimental and the control groups were analyzed using mean scores, standard deviation, t-test analysis and analysis of variance based on the two formulated null hypotheses tested at an alpha level of 0.05 in order to determine the existence of significant differences.

Research Question One

Is there any difference in the attitude of students taught using problem-solving instructional strategy and those in the control group?

The analysis in table 1 revealed that the mean gain score of the experimental group was 38.28 while that of the control group was 23.46. Thus, the mean gain difference between the two groups was 14.82 in favour of the experimental group (problem-solving instructional strategy).

Hypothesis One: There is no significant difference in the students' attitude when exposed to problem-solving instructional strategy and those in the control group.

The analysis in table 2 reveals that the t-value was 5.232 and the significant level was .000. Thus the probability of the null hypothesis is less than the critical value ($p < 0.05$). This implies that there is a significant difference in the attitudes of students in the experimental group and those in the control group in favour of the former with the mean difference of 15.44. Hence, the null hypothesis was rejected.

Research Question Two

Is there any difference in the attitude of high, medium and low scoring levels students exposed to problems-solving instructional strategy?

The analysis in table 3 shows the mean gain scores of attitude of the students in the experimental group as categorized into low, medium and high scoring levels. It was inferred from the table that students in the high scoring level category have the highest mean gain score of 64.39 followed by those in the medium group with 35.21 and those in the low group having 23.60. Further analysis was done to test whether the difference in the means was statistically significant; this is shown in table 4 below.

Hypothesis Two: There is no significant difference in the students' attitude based on scoring levels when exposed to problem-solving instructional strategy.

Table 4 shows that the *F*-value is 84.476 and the significant level is .000. Thus the probability of the null hypothesis is less than the critical Value ($p < 0.05$). This connotes that there is significant difference in the attitudes of students exposed to problem-solving instructional strategy at the three different scoring levels of low, medium and high. Thus, the null hypothesis was rejected.

Discussion

In this study the t-test analysis of hypothesis one revealed that the experimental group exposed to problem-solving strategy performed significantly better in Mathematics problem-solving than the control group. This attests to the efficacy of problem-solving instructional strategy as a tool for improving students' attitude towards Mathematics. This finding was

corroborated by the findings of Adeniran (2011) who sought the effect of two problem-solving approaches on senior school students' performance in physics in Kwara State of Nigeria. The researcher compared the performance of students taught using physics specific problem-solving approach target task and the lecture method. The finding showed that the post-test mean gain scores of students taught using the two problem solving approaches was greater than those exposed to the lecture method.

Also, ANOVA of hypothesis two revealed that differences in the performance of high, medium and low scorers exist when taught Mathematics using problem-solving instructional strategy with the high scorers benefiting more, followed by the medium scorers and the low scorers in that order. In the same vein, Sarwar (2002) concluded that high academic achievers have better study and more positive study attitude than low academic achievers.

Conclusion

Findings from this study revealed the efficacy of the problem-solving instructional strategy at improving students' attitude towards Mathematics. Other findings from this study include the fact that the strategy was beneficial to all ability levels irrespective of the standard of the members of such groupings with low scorers benefitted more. Therefore, it can be established that problem-solving instructional strategy is more relevant a improving students' attitude towards mathematics, especially for the weak students.

Recommendations

The following recommendations are considered appropriate and relevant based on the findings of this study:

Problem-solving instructional strategy should be used in teaching Mathematics at both primary and secondary levels of education.

More time should be allotted to Mathematics lessons (i.e double period)

Authors of Mathematics textbooks should include the instructional strategy at which each topic should be taught in their textbooks.

References

- Adeniran, (2011)** "Effects of two problem-Solving Approaches on Senior School Students' Performance in Physics in Kwara State Nigeria" Unpublished Ph.D Thesis, University of Ilorin, Nigeria.
- Ayinla, J. O. (2011)** "Effect of Teachers' Instructional Strategy Pattern on Senior School Students' Performance in Mathematics Word Problems in Ondo, Nigeria" Unpublished M.Ed. Thesis, University of Ilorin, Ilorin, Nigeria.
- Bednar, A., & Levie, W.H. (1993).** "Attitude-Change Principles". In Instructional Message Design: Principles from the Behavioural and Cognitive Sciences by M. Fleming & W.H. Levie, Eds., Englewood Cliffs, NJ: Educational Technology Publications. Vol. 2, pp. 283-304.
- Bolaji, C. (2005).** "A Study of Factors Influencing Students' Attitude Towards Mathematics in the Junior Secondary Schools: Mathematics Teaching in Nigeria". Retrieved on March 25 2010 from <http://www.2.ncsu.edu/ncsu/aern/bolajim.html>
- Boliner, G., & Wanke, M. (2002).** "Attitudes and Attitude Change". New York: psychology press, Taylor & Francis Group.
- Burstein, L. (1992).** "The Analysis of Multilevel Data in Educational Research and Evaluation". Review of Research in Education; Vol. 8, pp. 158-223.
- Butty, J.I.M. (2001).** "Teacher Instruction, Student Attitudes, and Mathematics Performance among 10th And 12th Grade Black And Hispanic Students". Howard University. Provided By Pro Quest Information And Learning Company.
- Cobb, P., Wood, T. & Yackel, E. (1991).** "A Constructivist Approach to Second Grade Mathematics". In Radical Constructivism in Mathematics Education by Von Glaserfeld, E, Eds., Dordrecht, The Netherlands: Kluwer Academic Publishers pp. 157-176.
- Crow, L.D. & A. Crow. (1999).** "Educational Psychology". Eursia Publishing House. New Delhi, India.pp.247-351.
- Ebeh, O.C. (2000).** "Strategies for Increasing Female Enrolment in Mathematics For

Technological Development in the Next Millennium” Journal of the Mathematical Association of Nigeria, Vol.25, No.1, pp.84 – 91.

Eraikemen, L & Oteze, K.I. (2008). “Students’ Choice of Mathematics as a Course of Study: Implications for Scientific and Technological Development” Journal of the Mathematical Association of Nigeria. Vol. 33, No. 1, pp. 64 – 69

Federal Republic of Nigeria. (2004). “National Policy on Education” 4th edition, Lagos. NERDC Press.

Hart, L. (1989). “Describing the Affective Domain. Saying What We Mean” in *Affect and Mathematics Problem Solving* by Mcleod & Adams, Eds., Springer Verlag: New York, pp.37- 45

Hoyles, C., Wolf, A., Molynuex-Hodgson, S. and Kent, P. (2002) “Skills in the Workplace” London: Institute of Education.

Kamradt, T.F., & Kamradt, E.J. (1999) “Structured Design for Attitudinal Instruction” in *Instructional-Design Theories and Models: A New Paradigm of Instructional Theory* by C.M. Reigeluth, Ed., Mahwah, NJ: Lawrence Erlbaum, Vol. 2, pp 563-590.

Kanckar, S.(1989) “A Comparison of the Study Habits and Attitudes of Low and High Achiever Female Students. Pakistan Education Journal. Vol. 5, No. 8, pp.89 – 100.

Lester, F.K.Jr., Masingila, J.O., Mau, S.T., Lambdin, D.V., dos Santon, V.M. & Raymond, A.M. (1994) “Learning How to Teach via Problem Solving” in *Professional Development for Teachers of Mathematics* by Aichele, D. and Coxford, A. (Eds.), Reston, Virginia: NCTM pp. 152-166.

Ma, X. & Kishor, N. (1997) “Assessing the Relationship Between attitude Toward Mathematics and Achievement in Mathematics: A Meta-Anaalysis” *Journal for Research in Mathematics*, Vol.28, No.1, pp.26-47.

NCTM (1980) “An Agenda for Action: Recommendations for School Mathematics of the 1980s” Reston, Virginia: NCTM.

NCTM (1989) “Curriculum and Evaluation Standards for School Mathematics” Reston, Virginia: NCTM.

National Council for Teachers of Mathematics (2000) “Principles and Standards for School Mathematics” Reston, VA: NCTM.

NMC Abuja. (2009) “Mathematics Improvement

Programme” www.nmcabuja.org/mathematics_improvement_programmes.html. Retrieved on 26th July 2010.

O’Brien & Porter (1994) “Girls and Physical Science: The Impact of a Scheme of International Project on Girls Attitudes to Physics” *International Journal of Science Education* Vol. 14, No. 3, pp. 327 – 341.

Odogwu, H.N. (2002) “The Mathematics Teacher Factor in the Achievement of the Goals of the Universal Basic Education (UBE)” *Journal of Mathematical Association of Nigeria*. Vol. 27, No. 1, pp. 72 – 79.

Odunsi, T.O. (1994) “A Study of the Attitudes of some Nigerian Teachers towards Science and Science Teaching” *Journal of Research in Curriculum* Vol. 692, pp. 205- 211.

Olatoye, R.A.(2001) “A Causal Model of School Factors as Determinants of Science Achievement in Lagos State Secondary Schools” Unpublished Ph.D Thesis, University of Ibadan, Ibadan.

Onwu, G.O.M.(1981) “Learning Difficulties in Chemistry: Capacity limitation or Strategy Deficit” *African Journal of Educational Research* Vol. 4, No.1 & 2, pp. 125.

Sarwar, M.(2002) “A Comparison of Study Habits and Attitudes of Low and High Achievers at Secondary Level” M.Phil. Thesis Uni. A.I.O. Islamabad. 124

Schoenfeld, A. (1994) “Reflections on Doing and Teaching Mathematics” in *Mathematical Thinking and Problem Solving* by A. Schoenfeld, Ed., NJ: Lawrence Erlbaum Associates: Hillsdale, pp. 53-69.

Shah, M. (2002) “Comparative Effectiveness of Teacher Training in Enhancing the Professional Attitudes of B.Ed. Students Admitted in Institutes of Education And Research NWF” College Of Education Islamabad And Allama Iqbal Open University Islamabad. Ph.D. thesis Uni. A.I.O. Islamabad. P.232.

Smith, A. (2004) “Making Mathematics Count: The Report of Professor Adrian Smith’s Inquiry into Post-14 Mathematics Education” The Stationery Office : London.

Van Zoest, L., Jones, G. and Thornton, C. (1994). “Beliefs about Mathematics Teaching held by Pre-service Teachers involved in a First Grade Mentorship Program” *Mathematics*

Education Research Journal, Vol. 6, No. 1, pp. 37-55.

Weber, K. (2008) “Mathematicians Validation of Proofs” Journal for Research in Mathematics Education, Vol. 39, No. 4, pp. 431-459.

Yara P.O. (2009) “Relationship Between Teachers’ Attitude and Students’ Academic Achievement in Mathematics in Some Selected

Senior Selected Senior Secondary Schools in Southwestern in Nigeria” European Journal of Social Sciences. Vol. 11, No. 3, pp.364- 375

Zan, R. & Martino, P.D. (2007) “Attitudes Towards Mathematics: Overcoming Positive/Negative Dichotomy” The Montana Mathematics Enthusiasts Monograph Vol. 3, pp 157-168.

Table-2: t-test analysis on post-test scores of the experimental and control groups.

		t-test for equality of means			
		T	Df	sig. (2-t)	Mean diff.
Post-test scores:					
Equal variances assumed		5.162	171	0	15.439
Equal variances not assumed		5.232	160.342	0	15.439

Table-3: Mean Gain Scorers of Attitude Performance Based on Scoring Levels.

Group	Group Statistics	Pre-test	Post-test	Mean Gain Score
Low Scorers	N	20	20	
	Mean	4.1	27.7	23.6
	SD	3.972	10.653	
Medium Scorers	N	52	52	
	Mean	12.92	48.13	35.21
	SD	8.679	17.398	
High Scorers	N	18	18	
	Mean	11.72	76.11	64.39
	SD	7.668	20.376	

Table-4: ANOVA Computation of the categorized Experimental group into Low, Medium and High scorers

Source	Sum of Squares	Df	Mean Square	F	Sig.
Model	243284.221	4	60821.055	243.661	.000
Covariate (Pre-test)	3185.256	1	3185.256	12.761	.001
Group	63259.203	2	21086.401	84.476	.000
Residual	21466.779	86	249.614		
Total	264751.00	90			