EFFECT OF REDA'S PROBLEM SOLVING METHOD OF TEACHING ON STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION BASED ON GENDER IN METAL WORK TECHNOLOGY IN SECONDARY SCHOOLS

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Abstract: This study was designed to determine the effect of Reda's problem-solving model on secondary school students' academic achievement and retention based on gender in metal work technology. The study adopted the quasi-experimental research design, precisely, pre-test, post-test non-equivalent control group design. The population for the study was 1,210 secondary school (SS III) metal work students. This study was conducted in Enugu State, Nigeria. Two research questions and two hypotheses tested at 0.05 level of significance guided the study. The instrument used for data collection was Metal Work Cognitive Achievement Test (MWCAT). The instrument was validated by three experts. Kuder-Richardson 20(K-R20) and Pearson product moment correlation coefficient, were utilized to establish the coefficient of internal consistency, and stability of the MWCAT. The test scores generated from the pre-test and post-test using MWCAT were analyzed using mean and analysis of covariance (ANCOVA) to answer research questions and for testing the null hypotheses. The findings revealed that there was no significant effect of gender on students' achievement and retention in metal work technology.

Keywords: Reda's problem solving model, Traditional teaching method, Academic achievement, Retention, Gender.

INTRODUCTION

Metalwork technology is the preparatory aspect of vocational education. vocational education is that form of education which is obtainable at the technical colleges, equivalent to the senior secondary education but designed to prepare individuals to acquire practical skills, basic and scientific knowledge and attitude required as craftsmen and technicians at sub-professional level (Federal Republic of Nigeria, 2004). Metal work technology is a subject aimed at studying the technical competencies in trade-related areas which include welding and fabrication, foundry and forging and machine shop practice. Metal work technology according to Nwaodo and Ogbonna (2019) refers to activities of using metals or metal-based materials for the purpose of fabrication, construction and other associated project and design activities.

Federal ministry of Education (2004) defined metal work technology as a vocational subject offered at the senior secondary schools and technical colleges for the purpose of enabling students to acquire further knowledge and develop skills. It exposes students to career opportunity by exploring usable options in the world of work, and enable youths to have an intelligent understanding of the increasing complexity of technology. However, these objectives are yet to be achieved in secondary schools as a result, poor academic achievement of students in metal work technology have been recorded in recent times. Researchers and school administrators have identified some factors militating against the attainment of the objectives to include teachers' methodology and techniques. To acquire the relevant learning experiences and skills in metal work for example, requires the use of relevant instructional methods and techniques.

Instructional methods and techniques are ways by which teachers present their course materials to students and engage them in the task of learning the curriculum contents. Instructional methods and techniques are the tools used by the teacher for actualizing the set aims and objectives (Bello and Aliyu 2013). The aims and objectives of teaching and learning will not be achieved if the tools are inappropriate or faulty. It is clear from the foregoing that the possibility of metal work technology to provide the needed solutions to the challenges of the millennium depends on the ability of metal work technology teachers to select and maximally utilize appropriate instructional techniques and methods for their lesson delivery. The teaching method are expected to reflect a modern society mandating the need for functioning, thinking-oriented and decision making students. There is an overall lack of political and public confidence in secondary school training system and a profound mismatch between the radically new key competences demanded from students in the knowledge society and teaching skills that teachers are equipped with, in teacher training institutions (Sani and Anaele, 2019). Nevertheless, the need for exposing the prospective students of metal work technology to quality knowledge and skills, both practical and cognitive, remains a necessity. School administrators maintain that the

task can only be accomplished with a radical change from the use of teacher-centered approach in secondary school programmes to the use of student-centered approaches such as the problem solving models (Nwaodo and Ogbonna 2019).

Problem solving method involves the identification and selection of problems arising from individual experiences of the students (Nwaodo and Ariyo, 2020). Problem solving method has been defined by many educationists in various ways with regard to its philosophical and psychological backgrounds. The Gestalt theorists according to Nwaodo and Ogbonna (2019) defined problem solving as an insightful or initiative process involving the perceptual processes of the solver. To them (the Gestalt theorists), problem solving is a type of discovery learning that depends on the learners' previous knowledge. Problems are placed before the learners and they are guided to the solutions. Problem solving method is highly very useful as it helps students to gain knowledge through active participation and autonomously find out information for themselves, thus promoting their level of intellectual productivity.

This technique encourages students to arrange and classify facts or data as well as allow students to learn from their successes and failures, since it permits the students to participate in their learning. If the necessary problem solving steps are known ahead of time, problem solving consist of the right steps to apply at their right time. If some of the problem solving steps are not known, then the problem solving process requires creating or inventing new ways to convert one state of a task into another. Study of novices and experts observed when solving textbook problems through the technique of protocol analysis has identified two types of problem solving steps: representing the problem representation in order to generate a solution. Representation involves translating the problem statement into a standard form that is accessible by principles. Once a representation has been created, problem solving proceeds by finding principles that will generate a solution. Problem solving sometimes fail because relevant principles are either not known or have not been learned. This study recommends the psychological view of problem solving because it consist of finding the right steps to apply at the right time or the creation/invention of new ways to convert one state of a task into another. That is, the representation of the problem situation and application of principles in order to generates a solution.

Many authors and researchers have proposed different models of problem solving in attempts to understand the problem solving of individuals and in their attempts to describe the problem solving process. The present study tend to investigate the effect of Reda problem solving model on students' achievement and retention in metal work technology based on gender in secondary schools. Reda (2008) stated that problem posing and problem formulation are logically and philosophically appealing notions to educators and teachers. Teachers skills during the uses of polya's four steps in problem solving should go consistently with their abilities to use suitable problem posing methods to generate more questions and problems for students. Reda feels that teachers might use one or more methods to formulate new problems or encourage their students in classes to be good problem posers as they are good problem solvers. Reda went ahead to state that problem posing situations could be classified as free, semi-structured or structured situations. Free problem posing situations is situation from daily life (in or outside school). Semi-structured problem posing situation is when students are given an open situation and are invited to explore it using knowledge, skills, concepts and relationship from their previous experiences while structured problem posing situation is any problem that consists of known data (given) and unknown (required).

The description of the 5-step plan of the Reda's (2008) problem solving model is as follows: understanding- determine what information is given in the problem and what one needs to find; make a plan:- After one has understood the problem, select a strategy for solving it; carry out the plan – solve the problem by carrying out the required plan; evaluate solution –examine the answer carefully to see if it fits the facts given in the problem; posing related problems- pose related problem by simply changing the unknown(s) in the solved problem that is change the condition of the current problem. The choice of this model is that it is a cyclic adaptation of polya's 1957 model but differ at the level of checking and posing related problems. Reda said that to check, examine your answer carefully to see if it fits the facts given in the problem. Then pose a related problem by simply changing the unknown(s) in the solved problem. Problem posing technique ensures further practice, understanding and evaluation of the concepts taught. It also raises a problem which leads into the future work when the days work is finished. It has therefore become necessary to use problem solving for teaching in metal work technology in secondary schools in order to determine its effect on students' academic achievement.

Students' achievement connotes performance in school subject as symbolized by a score or mark on an achievement test. Achievement is the measurement of the effects of specific programme of instruction or training (Kulbur, 2015). It can also be defined as something that somebody has succeeded in doing, especially, after a lot of effort. It is an act of finishing something successfully.

Relating this to achievement in this context means success in metal work when Reda's problem solving model is used as media of instruction in classroom teaching and learning. The problem of poor achievement of students could be attributed to poor instructional methods used by teachers in teaching metal work technology.

As a result, the students at the secondary schools find it difficult to cope with the required standard presented to them. Academic achievement of students can be best measured by test instrument such as objective test.

Presently, traditional method of instruction is predominantly used to teach metal work technology to students in secondary schools. Traditional teaching method is concerned with the teacher being the controller of the learning environment. They regard students as having knowledge holes that need to be filled with information. Learning is cheefly associated within the classroom and is often competitive. The lesson content and delivery are considered to be most important and students master knowledge through drill and practice (such as rote learning).

Nwaodo and Ogbonna (2019) maintained that traditional teaching method adopted by most teachers in the delivery of metal work technology do not seem to allow them to cater for the diverse learning styles of most students, engender appropriate level of interaction between the learner and the teacher and encourage neither creativity nor self study all of which factors may be linked to academic achievement and retention.

Retention has to do with ability to remember and apply previously learnt behavior. Retention in the view of Miller (2014) is the learning that last beyond the initial, unit of lesson and it is assessed with test administration two or more weeks after the information have been taught and tested. This means that a learner who is able to repeat an acquired piece of knowledge and skill with less error over time is said to have retained the knowledge and skill taught to him or her. Retention in context of this study means the ability of metal work students to repeat an acquired knowledge, skill and attitude in metal work technology over time with less error either through their responses to test administered on them or practical application of the acquired competency. Learning could be made clearer, easier and meaningful for better achievement and retention of the concept learnt. Reda's problem solving model could also reduce the perceived stereotyped status of female students in the sense that every students in the secondary school will have access to the model and learnt it at the same time and pace.

Gender is one of the factors that influence students' achievement and retention in metalwork technology at secondary school. Anakwe (2006) found items which account for gender disparity. These include among others, unequal access for female/male students to participate in classroom discussion, higher achievement level set for boys than girls and female students being assisted often in practical's, projects and other assignments even by some of their teachers. These could also affect students' achievement. However, the use of Reda's problem solving model in teaching and learning could improve students achievement and retention in metal work technology since some studies revealed that problem solving is gender friendly (Arbab, 2003; Rusbult, 2005 & Chado, 2009). Rusbult's (2005) stated that problem solving have been used in the developed countries to solve most of their educational problems. It could also be useful in Nigerian educational system to solve educational problems in metal work technology and other technical education courses.

Researches have been conducted in the areas of gender-related differences in the academic achievement of students in different areas. Some studies revealed that girls scored significantly higher than boys in science-related subjects (Ezeliora, 2007, Gimba, 2003). Contrary to this, Joiner, Messer, Littleton & Light, (1996); Ifamuyiwa (2004) and Iwende (2007) in their studies revealed that male students are academically superior to their female counterparts in computer and mathematics, yet some studies revealed that there was no significant difference in the performance of boys and girls when taught physics, chemistry and biology (Fagbemi, 2004; Dantala, 2005; Gbodi and Nworgu, 2006) respectively using Reda's problem solving model. The contradictive evidence in academic achievement due to gender has resulted in the need to verify how Reda's problems solving model can influence students achievement and retention by gender in metal work technology.

The issue now is that, can Reda's problem solving model be used effectively to sustain students achievement and retention in metal work technology putting into consideration, the influence of gender? Based on these, the researcher is aimed at determining the effect of Reda's problem solving model on students achievement in metal work technology.

Statement of the Problem

Problem solving is one of the instructional tools, it has to do with how learning can be affected and concretized. Research findings have shown that teaching and learning in the school system is predominantly teacher-centered and teacher directed (Nwaodo & Ogbonna 2019). The teacher centered activities may not aid and retain knowledge in metal work technology because the students ought to practice and show a certain degree of involvement in a skill to be said to have acquired it. Problem solving uses all available information (words, pictures and free information) to form a clear, complete mental picture of the problem situation. This is at a time when there is general concern over the apparent low performance of secondary school graduates, most especially those of metalwork technology who cannot cope with the world of work. The laudable objective of metal work technology according to NBTE (2009) is to produce skilled craftmen with good knowledge of the techniques and safety practical's involve in the workshop practice. Secondary school graduates of metal work technology have prospects of either being employed in the industries or set-up their own metal work workshop and become self employed.

Also, the secondary school products on graduation should have the opportunity of furthering their education in institution of higher learning. However, contrary to achieving the above goal, majority of students have been completing the programme with very poor academic performance and inadequate skills incapable of earning them a living (Miller 2014).

The West African Examination Council (WAEC) (2020) chief examiner's report observed that the poor performance of the students in WAEC examinations in recent years is partly due to the teaching method employed by teachers to teach. Moreover, it has been discovered that the persistent poor academic achievement and poor retention of students in metalwork and other subjects is as result of the inappropriate teaching methods adopted by teachers (Ogunbote, 2006). Nwaodo and Ogbonna (2019) commenting on the issue of poor quality of teaching method observed that the teacher-centered methods are the main teaching methods employed by teachers for implementing the curriculum. Obviously, the adoption of only teacher centered methods of teaching by the teacher results into ineffective use of varieties of instructional method and instructional facilities and inability of teacher to effectively implement the curriculum achievement and retention in learning. Despite the clear evidence of difficulties experienced by these students, technical education (including secondary schools) have not considered it necessary that skills for life long learning in technical and vocational education needs appropriate instructional strategies UNESCO 2002. It becomes pertinent to teach students of metal work technology at the secondary school with the problem solving which requires that schools should in addition to academic skills, inculcate workplace basic skills such as learning to learn, creativity, manipulate skills and higher order thinking skill to improve the students performance, flexibility and job mobility which will make them adaptable to the present and envisaged changes.

Students taught using solely teacher-centered method will obviously lack creative and manipulative skills required for work in the industry. This difference perhaps, may produce different effects on retention in metal work technology. This situation therefore prompted one to ask: what is the effect of Reda's problem solving model on secondary school students' academic achievement and retention based on gender in metal work technology?

Purpose of the study

The main purpose of this study is to investigate the effects of Reda's problem solving model on secondary school students academic achievement and retention in metal work technology based on gender. Specifically, the study determined:

1. The effect of Reda's problem-solving model on the achievement of student's based on gender in metal work technology.
2. The effect of Reda's problem-solving model on retention of students' based on gender in metal work technology.

Research Questions

1. The following research questions were formulated to guide the study.
2. What is the effect of Reda's problem-solving model on sudents' achievement in metal work technology based on gender?
3. What is the effect of Reda's problem-solving model on students' retention in metal work technology based on gender?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance

Ho1: There is no significant difference in the achievement scores of students taught metal work with Reda's problem solving model and those taught with traditional teaching method based on gender.

Ho2: There is no significant difference in the retention scores of students taught metal work with Reda's problem solving model and those taught with traditional teaching method based on gender.

Method

This study adopted a quasi experimental research design. Specifically, non-randomized control group pretest-posttest design was used for the study. White and Sabarwal (2014) stated that quasi experimental is an empirical study used to estimate the effect of an intervention on its target population without random assignment. Quasi experimental research design which involved subjects' randomization will disrupt academic activities of the schools involved in the study. Such random selection in true experimental design, according to Ezeudu and Ezeh (2008), is hardly permitted by the authorities of the school used for the research. Non randomized group (intact classes) is preferable for a study like this because it allows investigator or experimenter to make use of intact class so as to avoid disruption of the school programme. In quasi experimental research design, pre-test is administered at the beginning of the proposed study so that pre-test data can be used for finding out whether the subjects in the different groups are homogenous (equivalent) or not (Ali 2006).

Area of the Study

The study was carried out in 32 secondary schools that offers metal work technology in Enugu State. Enugu state is a traditional home of Igbo tribe in Nigeria as well as former capital of eastern region and

presently the state capital of Enugu state. This state is noted for its high educational attainment. Enugu state was chosen because it is developing technologically but still lacks enough qualified technicians to man emerging technologies for the benefits of the people.

Population of the Study

The population for this study consists of 1,210 senior secondary three (SSIII) students (1,112 males and 98 females) of metal work technology drawn from the 32 secondary schools offering metal work technology in Enugu state. Source: 2019/2020 session register of each of the 32 secondary schools.

Sample and Sampling Techniques

The sample size for this study was 68 metal work SSIII students: 39 students that consisted of 32 males and 7 females participated in Reda's model while 29 students that consisted of 24 males and 5 females participated in Traditional teaching method. A purposive sampling technique was used for selection of two secondary schools for this study thereafter, a simple random technique was equally used to allocate one school each to Reda's and Traditional teaching method respectively. Purposive sampling according to Nworgu (1991), is a sampling technique in which specific element are selected because of their relative importance or because they satisfy some pre-conditioned criteria, and because of administrative base of data collection. Thus from all the 32 secondary schools that offers metal work technology in the state those that satisfied the following conditions were purposively selected:

- The metal work teachers for the schools must be university graduates of not less than five years of teaching experience
- The school must have been presenting candidates for WAEC examination for the last four years consistently
- The schools that the principals and teachers must be willing to cooperate and participate in the study.

Intact classes in each school were used for the study such that all the students can benefit from the lesson. All SSIII metal work technology students in the two schools were the subject of the study.

Instrument for Data Collection

The instrument used for data collection was Metalwork Cognitive Achievement Test (MWCAT). The metalwork cognitive achievement test instrument was adapted from West African Examination Council (WAEC) past question papers. The content of the adapted questions covered the syllabus of the class chosen for the study. Metal work Cognitive Achievement Test (MWCAT) was a 40 multiple choice items with four option drawn from Bench work and General metal work module. The construction of test item was based on WAEC MWT trade curriculum and table of specification.

Validation of the Instrument

One subject expert in metal work with West African Examination Council and two experienced metal work teachers drawn from secondary schools in Enugu State, Nigeria were requested to carry out both face and content validation on MWCAT. The experts were requested to carry out validation under the following guidelines: If the items were within the scope of the concepts selected; If the items were within the reach/scope of the students in terms of language expression; If the objectives being evaluated were satisfactory, If the items where within the level of objectives being investigated. The content validation involved the validators confirming/ ensuring that the content of the instrument were in agreement with the course contents. The comments and suggestions on the instrument by the validators were incorporated into the final draft of the instrument. It entailed checking the MWCAT items against the topics and contents of the lesson plan. The content validation was accomplished by making sure that the test items reflected the specifications on the test blue print.

Reliability of the Instrument

A trial test of the instrument was carried out for the purpose of determining the coefficient of stability of the Metal Work Cognitive Achievement Test (MWCAT) using test retest reliability technique. The instrument was administered on twenty two SS III metal work technology students in Abakaliki Ebonyi State, which is outside the study area. The objective answer sheets were marked by the researcher and scores obtained. The first and second scores of the test were correlated. The reliability coefficient of the MWCAT was determined using Pearson product moment correlating coefficient. Reliability of 0.81 was gotten showing that MWCAT was stable.

To determine the estimate of internal consistency reliability of this instrument which was administered only once on the testees, Kuder Richardson 20(K-R20) formula was used. This is because K-R20 is mostly applicable to test that are dichotomously scored, that is either pass or fail, right or wrong or multiple choice instrument like the one in this study (Obi,2006). The reliability of 0.97 was gotten.

Experimental Conditions

1. Experimental Bias: To avoid experimental bias, the same test was given to both groups at the same time. The students in both groups were not informed that they are being involved in any research process, because this will enable them to behave naturally and prevent them from acting in any manner that could influence the research either negatively or positively. The secondary school teachers in the participating

schools were involved in teaching their students in both experimental and control groups. Also, the researchers were not directly involved in test administration. The participating schools are far from each other. The same lesson contents were also given to both groups.

2. Teacher variability: In order to control invalidity that could be caused by this variable, and to ensure uniform standard in the conduct of the research, the researchers personally prepared the teaching instrument (Reda's problem-solving model lesson plan and Traditional teaching method lesson plan). In addition the participating teachers were trained by the researchers for effective conduct of the research/experiment. The secondary school teachers were allowed to teach and evaluate their students
3. Training of Teachers: A two week intensive training was organized for the participating teachers by the researchers on the Reda's problem solving model and other research expectation. The teachers were briefed on the general requirements of the research since they were expected to use both lesson plan to teach students in their normal classes. At the end of the training, the researchers evaluated the participating teachers of experimental group to be sure they mastered the teaching methods expected of them and they proved themselves brilliantly. After the training of the teachers, pre-test was given to the student's before teaching began.

Experimental procedure

The conduct of the study took place during the normal school lesson periods. The normal time table of the schools used for the study was followed. The regular school metal work technology teachers were used as research assistants. The intact groups were used for the experiment. The trained teachers were supplied with the facilities. Topics to be taught were given to both groups. Established scheme of work was used with reference to curriculum. Each group was taught with five lesson plans. The treatment lasted for four weeks. The treatment for this study was Reda's problem-solving lesson plan. Each lesson plan lasted for 90 minutes.

On the first day, before the lesson commences, the MWCAT were administered as pre-test to both the Reda's model and the Traditional teaching method after which proper teaching commenced by using the prepared lesson plans. At the end of the treatment, a post-test was administered on both groups with the MWCAT. After two weeks of administering the post-test, a test of retention of learning was given to the groups and the scores obtained from both groups were compared to determine if there is any significant difference in achievement and retention of the two groups.

Method of Data Collection

The scores obtained from pre-test, post-test and retention test administered on SS 3 students of secondary school using MWCAT were used as the data collected for the study. The metal work teachers from the two schools were briefed to administer the MWCAT to students in an examination conditions. The scores obtained by the two groups were compared using appropriate statistics.

Method of Data Analysis

The data collected from the administration of pre-test, post-test and retention of learning were analyzed using mean to answer the research questions. Standard deviation shows the closeness of the results to the mean. The pre-test, post-test mean gain of each of the groups were compared to determine the group that performed better. The null hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. The use of ANCOVA was to control the errors of the initial non-equivalence arising from the use of intact classes as subjects of the study. With the use of ANCOVA, too, the pre-test result served as covariate of the post-test results, so as to block the effect of covariate on the post-test.

Presentation and Analysis of Data

Table 1:

Mean and Standard Deviation of achievement Scores of Students Taught Metalwork Based on Method and Gender

method	gender	Pretest Score			posttest Score		Mean gain/loss
		N	Mean	SD	Mean	SD	
Reda's Model	Male	32	35.59	8.18	63.91	22.09	+28.32
	female	7	31.43	10.99	69.57	25.98	+38.14
Traditional Teaching Method	Male	24	27.92	11.82	31.79	6.59	+3.87
	female	5	25.80	7.39	26.20	8.67	+0.40

Table 1 reveals that pretest achievement mean and standard deviation scores for male students in Reda group are 35.59 and 8.18, while that of females in the same group are 31.43 and 10.99. Also posttest achievement mean and standard deviation scores for males in Reda group are 63.91 and 22.09 with mean gain score of 28.32, while that of females in the same group are 69.57 and 25.98 with mean gain score of 38.14.

Similarly, pretest achievement mean and standard deviation scores for males in traditional teaching method are 27.92 and 11.82, while that of females in the same group are 25.80 and 7.39. Again, posttest mean and

standard deviation scores for males in the traditional teaching method are 31.79 and 6.59 with mean gain score of 3.87, while that of females in the same group are 26.20 and 8.67 with mean gain score of 0.40.

Table 2

Analysis of Covariance (ANCOVA) of Students Mean Achievement Scores Based on Method and Gender

Tests of Between-Subjects Effects

Dependent Variable: posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	23390.806[a]	4	5847.701	18.036	.000
Intercept	13600.604	1	13600.604	41.948	.000
Pretest	50.887	1	50.887	.157	.693
Method	14961.603	1	14961.603	46.146	.000
Gender	21.246	1	21.246	.066	.799
method * gender	136.811	1	136.811	.422	.518
Error	20426.179	63	324.225		
Total	207183.000	68			
Corrected Total	43816.985	67			

a. R Squared = .534 (Adjusted R Squared = .504)

Table 2 indicates that F-ratio (0.066) with associate probability (sig(2-tailed)(p=0.799) under gender being greater than significant level(0.05) postulated. Hence, the alternative hypothesis was upheld. Therefore, there is no significant difference between the mean achievement scores of students taught metalwork with Reda's model and those taught with Traditional teaching method based on gender. This shows that both Reda's and Traditional teaching method are gender friendly.

Table 3:
Mean and Standard Deviation of Retention Scores of Students Taught Metalwork Based on Method and Gender

Method	gender	Posttest Score			Retention Score		Mean gain/loss
		N	Mean	SD	Mean	SD	
Reda's Model	male	32	63.91	22.09	74.94	20.74	+11.03
	female	7	69.57	25.98	74.94	20.52	+5.37
Traditional teaching method	male	24	31.79	6.59	36.46	8.98	+4.67
	female	5	26.20	8.67	32.00	7.58	+5.80

Table 3 reveals that posttest achievement mean and standard deviation scores for male students in Reda group are 63.91 and 22.09, while that of females in the same group are 69.57 and 25.98. Also, posttest achievement mean and standard deviation scores for males in Traditional teaching method are 31.79 and 6.59, while that of females in the same group are 26.20 and 8.67. Also retention mean and standard deviation scores for males in Reda group are 74.94 and 20.74, while that of females in the same group are 74.94 and 20.52 with mean gain of 11.03 for male and 5.37 for female students in the same group.. Again, retention mean and standard deviation scores for males in the Traditional teaching method are 36.46 and 8.98, while that of females in the same group are 32.00 and 7.58 with mean gain of4.67and 5.80 for male and female students in the same group.

Table 4
Analysis of Covariance (ANCOVA) of Students' mean Retention Scores Based on Method and Gender

Tests of Between-Subjects Effects

Dependent Variable: retentiontest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9984.899[a]	4	2496.225	8.998	.000
Intercept	3633.545	1	3633.545	13.097	.001

Pre retention	467.963	1	467.963	1.687	.199
Method	4838.120	1	4838.120	17.439	.000
Gender	90.532	1	90.532	.326	.570
method * gender	18.228	1	18.228	.066	.799
Error	17478.321	63	277.434		
Total	192993.000	68			
Corrected Total	27463.221	67			

a. R Squared = .364 (Adjusted R Squared = .323)

Table 4 indicates that F-ratio (0.326) with associate probability (sig(2-tailed)(p=0.799) under gender is greater than significant level(0.05) postulated. Hence, the null hypothesis was upheld. Therefore, there is no significant difference between the mean retention scores of students taught metalwork with Reda's model and those taught with Traditional teaching method based on gender. This reveals that both Reda and Traditional teaching method are gender friendly or unbiased method in terms of retention.

Discussion

Findings reveals that male students taught metalwork with Reda's model had a mean score of 35.59 in the pre-test and a mean score of 63.91 in the post-test while the female taught metalwork with the same models had a mean score of 31.43 in the pre-test and a mean score of 69.57 in the post-test but in the Traditional teaching method, the male students had a mean score of 27.92 in the pre-test and a mean score of 31.79 in the post-test while the female counterpart had a mean score of 25.80 in the pre-test and a mean score of 26.20 in the post-test. The statistics shows that Reda's problem-solving model leads to considerable improvement of students' academic achievement in metal work than traditional teaching method. However, both methods are gender friendly. This is in agreement with Fagbemi, 2004; Dantala, 2005; Gbodi and Nworgu 2006 who revealed that there was no significant difference in the performance of boys and girls when taught physics, chemistry and Biology with Reda's problem solving model. The Analysis of covariance shows that there is no significant difference between the mean achievement scores of students taught metalwork with Reda's model and those taught with Traditional teaching method based on gender.

Findings reveals that male students taught metalwork with Reda's model had a mean score of 63.91 in the post-test and 74.94 in the ret-test while their female counterpart had a mean score of 69.57 in the post-test and 74.94 in the ret-test but with Traditional teaching method, the male students had a mean score of 31.79 in the post test and 36.46 mean score in the ret-test while their female counterpart had a mean score of 26.20 in the post-test and a mean score of 32.00 in the ret-test. It implies that both male and female students in the Reda's model and Traditional teaching method retained information better on metalwork showing that they are gender friendly. The Analysis of covariance revealed that there is no significant difference between the mean retention scores of students taught metalwork with Reda's model and those taught with Traditional teaching method based on gender.

Conclusion

This study was set out to determine the effect of Reda's problem solving models on secondary school students' academic achievement and Retention in metal work. In the conducting of the study, the study took into consideration gender (male and female) as a moderator variable which can influence the dependent variable. The study revealed that both Reda's model and traditional teaching method are effective but that Reda's model is more effective in improving students' academic achievement and retention in metal work technology. This result therefore showed that Reda's problem solving model is a viable alternative to the teacher centered method of teaching metal work technology. Instructional method such as Reda's problem solving model give teachers opportunity to engage students in real world of classroom exercises.

It gives students the opportunity to develop valuable thinking skill and acquire an understanding about the technology world. Thus, if Reda's problem solving model is adopted to teach metal work in secondary schools, students will, undoubtedly, be equipped with knowledge and skills in metal work as well as perform and cope more effectively with requisite metal work skills needed for work in the industry, for self reliance and present world of work.

Recommendations

Based on the findings of this study, the following recommendation are made:

1. The study recommends the teaching/learning of metal work via Reda's problem solving model
2. Seminars, workshops and in-service programmes should be organized by all examination boards (WAEC and NECO) to enlighten secondary school teachers and improve their knowledge and skills on the use of Reda's problem solving model for improving students performance in metal work technology.

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