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Effects of Self-Instructional Learning Strategy on Secondary Schools Students' Academic Achievement in Solving Mathematical Word Problems in Nigeria

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Abstract

The study investigated the effects of self-instructional learning strategy on students' achievement in solving Mathematical word problems. The research determined whether self-instructional learning strategy has significant effects on the learning achievement of senior secondary school students. Three research questions and two null hypotheses guided the study. The study utilized the non-randomized control group pre-test post-test experimental design. The sample consisted of 131 subjects with mean age of 16.02 years from four schools chosen through simple sampling techniques. Students of *the experimental group were instructed in four units of Mathematics syllabus using self-instructional method. On the other hand, the control group was taught the same topics in Mathematics using the conventional teaching method. Mathematics Achievement Test instrument developed and duly validated by experts was used to collect data. Data collected were analysed using mean for the research questions and Two-way Analysis of co-variance was used to test the hypotheses at 0.05 level of significance. Major findings of the study indicate that there was significant main effect of treatment (self-instructional learning strategy) on the student's mathematical word problem achievement. The effect of gender on mathematical word problem achievement was found insignificant. However, a significant interaction effect was observed between gender and learning strategy. Thus, males in the experimental group significantly performed better than their female counterparts. Based on these findings, educational implications of the study were raised.*

Key words: Self-Instructional learning Strategy, Gender, Mathematical Word Problem

Introduction

Formal education, generally, is seen as a means of imparting and acquiring knowledge. This is done through teaching and learning within the four walls of a school. The school system is established to facilitate teaching and learning. It empowers the students with necessary knowledge and skills for an effective living in the society. It is expected that classroom learning be transferred into solving problems in real life situation. The present Nigerian educational system seems to be far from achieving the desired educational goals and objectives as there are noticeable evidences of decline in the standard of education and quality of students especially at the secondary school level (Duze, 2011). This is glaringly clear in the results of both internal and external examinations especially in Mathematics. The situation has really attracted the interest and concern of teachers, psychologists, researchers, parents and school administrators in Nigeria (Ajayi & Muraina, 2011)**.**

Ifedili and Ojogwu (2007) averred that the falling standard of education manifested in the performances of students at various examinations is leaving many people to wonder about the future and place of Nigerian education in the 21st century. So many factors have been pointed at as responsible for the poor performance of Nigerian secondary school students. Some of these factors include teaching and learning methods, inadequate instructional facilities, students' lack of interest and motivation. Appeh (1999) observed that poor preparation of the students due to poor teaching and dearth of facilities are considered as the main reasons for students' poor performance at public examinations. The inability of students to engage actively in the learning process tends to dispose the students to constant rote learning and examination malpractice leading to their poor academic performance. In relation to the above, Biehler and Snowman (1990) argued that lack of students' exposition to metacognitive strategies creates their difficulty to explain their learning process. This ultimately results in their resorting to rote and blind memorization of concepts to pass examination.

Furthermore, Okpala (1985) cited in Awolabi (2003) observed that the conventional teaching method in most Nigerian classrooms is more teacher-centred than learner centred. Emphasis seems to be on teaching than learning with less attention to the 'process' of learning or 'how' the students learn. This has dwarfed the students' creative thinking which is necessary in today's workplace. Hence Tamblyn (2003) observed that the traditional style of teaching fails in teaching learners to think creatively. Given this scenario, there is need to engage the students in creative thinking as it develops solving problem skills. This can be achieved by making learners the centre of learning activity in order to take charge of their learning as to become self-instructed learners.

Nevertheless, Flavell (1976) noted that a self regulated learner is an independent learner who is able to transform his mental abilities into academic skills. Such a learner is able to monitor and regulate his cognitive activities, as well as other processes and functions associated with metacognition In order to gain access, monitor and regulate one's cognitive activities, certain strategies like; self instruction, self-monitoring, etc, are necessary. Hence, Montague (2008) noted that self-regulation strategies like self-instruction, self-questioning, self-evaluation, self-monitoring and self-reinforcement, help learners in gaining access to cognitive processes that facilitate learning, guide learners as they apply the processes within and across domains, and regulate their application and overall performance task.

Mathematics is an important school subject that is associated with more academic and career opportunities (Akinsola & Tella, 2001). Burton cited in Agwagah and Usman (2002) relates the importance of mathematics to the scientific, industrial, technological and social progress of a society. It is a science that studies numbers, shapes, objects and their properties which are needed as basic requirement for all sciences. Gretchen (2003) observed that instruction on mathematical word problem guides students to actively participate in their learning environments and make constructive, productive contributions to what they learn.

Over the years, students' performances in Mathematics have been poor. From available statistics, the national average hovers around 32 per cent for Mathematics. Uwadie (2010) in support of the above assertion noted that it was only 48.88% of candidates who sat for November/December 2010 West African Senior School Certificate Examination (WASSCE) credited Mathematics. The 2011 June/July SSCE results also recorded mass failure by students across the country. In mathematics, 1, 156, 561 students sat for the examination with only 3,356 representing 0.28% obtaining distinction. 295, 961 or 24.86% got credit while 77,395 or 60.27% got pass. 98.023 representing 7.48% failed while 50,826 or 4.27%were involved in malpractice. By implication, only 25.14% (distinction and credit percentage) is qualified for admission into universities and polytechnics.

Some authors, like Montague (2003) and Swanson (1999) had expressed the opinion that students who are poor mathematical problem solvers do not process problem information effectively or efficiently. They either lack or do not apply the resources needed to complete complex cognitive activity. These students generally lack metacognitive or self-regulation strategies that help successful students understand, analyze, solve and evaluate problems. Teachers should, therefore, understand and teach cognitive processes and metacognitive strategies used by good problem solvers in other to assist these students to become good problem solvers. One of these strategies is self-instruction.

Holec (1988) stated that self–instruction is concerned with responsibility in learning. It describes a situation in which learners can assume varying degrees of responsibilities for their learning. For self- instructed learning to occur, two conditions must be satisfied; firstly, the learner must take care of his learning by making decisions concerning all aspects of learning including determining the objective, defining progressions, selecting techniques used and evaluating what has been acquired. To do this, the learner is trained in certain learning strategies like planning and organizing, evaluating, practicing, timed practicing, developing and using memory aids, getting help, asking for correction and peer-learning. Secondly, there must be a learning structure in which the learner can exercise control over the learning process. Therefore, for learners to succeed in self-instruction, they must have the skills to manage their own learning.

Self-instructional strategy, in the context of this work, is a cognitive and metacognitive learning instructional strategy. It involves the use of designed instructional package so that students can learn either without a teacher's intervention or with minimum guidance while applying different learning skills and strategies. It is, therefore, a student centred learning strategy that focuses on the monitoring of cognitive processes of an individual's problem solving. Application of self-instructional learning strategy has been linked to student's performance improvement in solving word problems in Mathematics.

There are some research-based instructional models which can assist students to instruct themselves while solving mathematical word problems. They include, among others, STAR Cognitive Strategy, Pólya's four-step process strategy, RIDGE strategy and Montague's cognitive –metacognitive instructional model. For this study, however, Montague's cognitive – metacognitive instructional model which is designed for solving mathematical word problems is adopted because, it is more comprehensive than other models, since it comprises many learning skills and strategies. It is also designed to assist middle and secondary school students who have difficulty solving mathematical word problems. Montague's instructional model consists of seven (7)- step cognitive processes; Read, Paraphrase, Visualize, Hypothesize, Estimate, Compute, and Check. It has also metacognitive (thinking about thinking) strategies in form of three-part self – coaching routine for each of the seven problem-solving steps that will automate the learner's awareness and ability to monitor the cognitive processes (See Appendix).

The ultimate goal of this instructional strategy is to have the students internalize the cognitive processes and metacognitive strategies in order to use them automatically while solving mathematical word problems. Solving mathematical word problem involves translating, transforming linguistic and numerical information into verbal, graphic, symbolic, and quantitative representations while evaluating the solution path, performing the appropriate calculations, and checking accuracy (Montague, Enders & Dietz, 2011). Hence, it is time consuming.

Since solving mathematical word problems requires extensive time, instruction on the application of time management techniques which in itself is an aspect of self-instruction, is built into the treatment package. Thus, a modified version of Montague's cognitive –metacognitive instructional strategy is applied in this study. It, therefore, has such skills like cueing, modelling, verbal rehearsal, practicing, feedback, goal setting, planning, time scheduling, organizing, self-questioning, monitoring and evaluating. The ultimate academic goal for students is to become independent learners, as well as problem solvers. In other parts of the world, Bryant and Budd (1982), Maccini and Hughes (2000), among others, have carried out a number of researches on self–instruction. But very little research has been done in Nigeria to either validate or disprove the effects of self-instructional learning strategy on secondary school students especially while solving mathematical word problems. This will be considered in this study.

Furthermore, researches have equally indicated that gender influences student's academic achievement. For example, in a metaanalysis of 77 studies conducted between 1980 and 1991 among middle and high school students, DeBaz (1994) found a significant gender effect favouring males in overall achievement in science. Kolawole (2008) investigated on the effects of cooperative and competitive learning on academic performance of students in Mathematics. The result, among other things, revealed that boys performed significantly better than girls in both learning strategies. This study also intends to determine the possible effects of gender on the student's academic achievement in solving mathematical word problems based on self – instruction training.

Statement of the Problem

The poor academic achievement especially in Mathematics in Nigeria with its attendant problems has been a great thing of worry to all stakeholders, such as parents, teachers, educational psychologists, counsellors, Government and the society at large (Aburime,2009). This is because Mathematics is today part of the basic requirements for entrance into the different stages of higher Educational system since it is the bedrock of all science and technologically-based subjects. It affects all aspects of human life at different degrees. This consistent poor performance by students in Mathematics calls for serious national action to remedy situation.

To correct this anomaly, a number of programmes have been embarked upon like introduction of new Mathematics textbooks, different Mathematics competitions, workshops and seminars. The problems seem to continue because these interventions are outside the learner. As a way out, Aburime (2009) decried that the incessant poor mathematics performance in Nigerian secondary schools has called for an overwhelming need for a review of current teaching and learning strategies.

Oyedeji (1998) remarked that conventional teaching method which is teacher-centered does not actively involve the students in the learning and problem-solving processes as they are predominantly passive. It, therefore, appears to inhibit development of students' intuition, imagination and creative abilities. Therefore, there is need to find more effective instructional strategies and model that are likely to improve achievement in solving word problems in senior secondary Mathematics.

In the developed part of the world, there have been shift to cognitive and metacognitive strategies like self-instructional learning strategy which has been found to improve students' performance in solving mathematical word problems (Burgio, Whiteman, & Johnson, 1980; Maccini, & Hughes, 2000). Incidentally, there has been very little research done in Nigeria in this area. This study is, therefore, centred on the effects self –instructional learning strategy has on the students' achievement while solving mathematical word problems using modified version of Montague's instructional model.

Purpose of Study

The main purpose of this research is to determine the effects of self - instructional learning strategy on secondary school students' achievement in solving mathematical word problems using modified version of Montague's instruction model.

Specifically this study will

1. determine the effect of training in self- instructional learning strategy on students' achievement in solving mathematical word problems when compared with the control group that are not trained.
2. determine if there are differences in the mean achievement scores of SSII males and females students in solving mathematical word problems.

3. find out if there is an interaction effect between gender and self-instructional learning strategy in the mean achievement scores of SS II experimental students in solving mathematical word problems.

Research questions

The following research questions guided this study:

1. What are the mean achievement scores in Mathematical word problems of SS II students given training in self-instructional learning strategy and those that are not trained?
2. What are the mean achievement scores in Mathematical word problems of SS II male and female students in experimental group?
3. What are the mean achievement scores in Mathematical word problem of SS II male and female students in control group?

Hypotheses

The following hypotheses guided the study:

1. There is no significant difference in the mean achievement scores in mathematical word problems of SS II students given training in self-instructional learning strategy and those that are not trained.
2. There is no significant interaction effect between gender and learning strategy in the mean achievement scores in mathematical word problems of SS II students trained in self-instructional learning strategy.

Method

The design for this study was quasi-experimental. This design involved the use of two intact class groups (experimental and control). It, therefore, utilized the non-randomized control group pretest - posttest design. The total sample size for this study was 131 subjects with mean age of 16.02 years. Using simple random sampling techniques, two schools were selected from the boys' secondary schools and another two from the girls' secondary schools. Hence, four schools were selected in the whole comprising of two boys' secondary schools and two girls' secondary schools.

Through simple random sampling, one of the two boys' secondary schools randomly selected was chosen as the experimental school while the other was the control school. Also, through simple random sampling, one of the two girls' secondary schools randomly selected was chosen as the experimental school while the other was the control school. Therefore, there were two experimental schools (a boys' school and a girls' school) and two control schools (a boys' school and a girls' school). Thus, from each of the experimental and control schools, one intact class was selected respectively through the simple random sampling technique. The boys' and girls' experimental classes had 25 and 35 subjects respectively while the boys' and girls' control classes had 40 and 31 subjects respectively.

Mathematics Achievement Test (MAT) was constructed by the researcher in conjunction with the research assistants who were Mathematics teachers in the experimental schools. MAT consisted of 20 word problem in Mathematics covering four units on SSII students' second term's scheme of works on which the experiment was based. The topics covered in the four units include Algebraic process, simple & quadratic equations and graph of quadratic equation from SS II second term's scheme. The test had five questions from each of the four units.

MAT developed was validated by an experienced Mathematics teacher from federal college, Onitsha and two experts from Nnamdi Azikiwe University, Awka; one in Mathematics department and the other in Measurement and Evaluation. These experts were given the research topic, purpose of study, research questions, hypotheses and scheme of work of the students in Mathematics and test instruments for effective validation. Hence they did the content validation. The relevant criticisms, comments and inputs by the experts were taken into consideration while modifying the instrument.

Reliability of MAT was determined by the test-retest method. The test was administered to an SSII Class of 16 boys and 21 girls of another school not used in the study. After a week interval, it was re-administered to the same students. Pearson Product Moment Correlation method was used to correlate each of the two sets of tests scores and a coefficient of 0.83 was obtained, indicating the reliability of the instrument.

The researcher organized three (3) days training for two research assistants. These research assistants were regular classroom teachers in Mathematics in the experimental schools. Their training specifically aimed at instructing them on; the concept and importance of self-instructional learning strategy, modified version of Montague's cognitive –metacognitive instructional model, self-instructional training steps, teaching and solving word problems using Montague's instruction model. The training was based on the scripted lessons for the self-instructional strategy training.

The treatment period lasted for eight (8) weeks altogether with thirteen (13) sessions of forty (40) minutes each. Prior to the commencement of the treatment on the experimental group, the trained Mathematics Class teachers in the experimental schools administered the pre-test to the treatment group while the regular classroom teachers (not trained) administered same to the participants in the control group. The pre-test involved the administration of the MAT in word problems Mathematics on both the treatment and control groups in their regular classrooms to determine the extent of students' achievement before the experiment.

The students in the treatment group were subsequently trained to instruct themselves while solving mathematical word problems applying the intervention: modified version of Montague's Model. This research-based learning instructional strategy consisted of seven steps ***(See Appendix A).*** They were further instructed in Mathematics topic on Algebraic process, simple & quadratic equations and graph of quadratic equation using Montague's model. The control group was taught the same topics by their teachers who were not trained using the conventional teaching method in mathematics.

After the administration of the treatment on the experimental group which covered training in self-instructional learning strategy using modified version of Montague's model, the researcher with the help of the classroom teachers administered a post-test on both the treatment and control groups one week after the treatment. The posttest was the same with the pretest only that the numbers were reshuffled.

The data collected were analyzed using mean to answer the research questions. Two-Way Analysis of Covariance (ANCOVA) was used in analyzing the null hypotheses.

Result

Research Question 1: What *are the mean achievement scores in mathematical word problems of SS II students given training in self-instructional learning strategy and those that were not trained?*

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Table 1: Mean gain scores of Students' achievement in mathematical word problems for Experimental and Control Groups

Group	N	Pre-test $\bar{X}$	Post-Test $\bar{X}$	Mean Gain Score $\bar{X}$
Experimental Group	60	25.21	38.43	13.22
Control Group	71	13.37	18.34	4.97

The table showed mean score of 25.21 and 13.37 for the experimental and control groups respectively for the pre-test, and 38.43 and 18.34 for the post-test. The mean gain score for the experimental group was 13.22 while that of the control group was 4.97. This showed that the experimental group had a higher gain score than the control group.

Research Question 2: *What are the mean achievement scores in mathematical word problems of SS II male and female students in experimental group?*

Table 2: Mean gain scores of SS II Male and female Students' achievement in mathematical word problems for the Experimental Group

Group	N	Pre-test $\bar{X}$	Post-test $\bar{X}$	Mean Gain score $\bar{X}$
Male	25	22.44	39.04	16.6
Female	35	27.2	38	10.8

The above table revealed that at the pre-test level, the 25 males in experimental group had mean score of 22.44 while their 35 female counterparts had 27.2. Also the post-test mean achievement score recorded 39.04 and 38 for male and female students respectively. The mean gain score showed 16.6 in favour of male students and 10.8 for the female. Thus, male students had 5.8 mean gain score than the females from pretest to posttest.

Research Question 3: *What are the mean achievement scores in mathematical word problem of SS II male and female students in control group?*

Table 3: Mean gain scores of Students' achievement in mathematical word problem for the SS II male and female students in control group

Group	N	Pre-test $\bar{X}$	Post-Test $\bar{X}$	Mean gain Score $\bar{X}$
Male	40	11.22	14.9	3.68
Female	31	16.12	22.77	6.65

The statistics above showed that at the pre-test level of the control group, male and female students had 11.22 and 16.12 respectively while at the post test level, they had 14.9 and 22.77 respectively. The mean gain score showed 3.68 in favour of male students and 6.65 for the female. Thus, female students had 2.97 gain score than the males from pretest to posttest.

Hypothesis 1: *There is no significant difference in the mean achievement scores in mathematical word problem of SS II students given training in self-instructional learning strategy and those that are not trained*

Table 4: Summary of mean gain achievement scores in mathematical word problems

	Group	gender	mean	std deviation	N
Gain Score	experimental	Male	16.600	12.629	25
		Female	10.800	9.336	35
		Total	13.216	11.109	60
	Control	Male	3.675	15.910	40
		Female	6.645	11.780	31
		Total	4.971	14.237	71
	Total	Male	8.646	15.944	65
		Female	8.848	10.677	66
		Total	8.748	13.497	131

Table 5: Summary of Two-way ANCOVA on the students' achievement mean gain score in mathematical word problems

Source of Variation	sum of squares	df	Mean Square	*F*	*P*
Pretest (Covariate)	2707.93	1	2707.93	18.83	.001
Learning strategy	4165.77	1	4165.77	28.97	.001
Gender	2.18	1	2.18	.02	.902
Learning strategy X Gender	618.27	1	618.27	4.3	.040
Error	18119.546	126	143.806		
Total	23682.687	130			

From the table 5, a significant main effect of self-instructional learning strategy on mean gain score in mathematical word problem was observed, F (1, 126) = 28.97, $p < .001$. Therefore null hypothesis is rejected.

Inspection of the means in Table 4 indicates that students taught with self-instructional strategy (M= 13.22, SD =11.11) performed better than those without the training (M = 4.97, SD = 14.24).

Hypothesis 2: *There is no significant interaction effect between gender and learning strategy in the mean achievement scores in mathematical word problems of SS II students trained in self-instructional learning strategy*

Table 5 shows that a significant interaction effect was observed, F (1,126) = 4.30, p<.04. Therefore, the null Hypothesis is rejected.

Table 4 reveals that males with self-instructional learning strategy (M=16.6, SD = 12.63) performed better than female with the same self-instructional strategy (M= 10.8, SD = 9.34).

Summary of major findings

From the result of the analysis, the following major findings emerged from the study.

1. The students that received training in self-instructional strategy performed significantly better than the control group who were not trained.
2. There is a significant interaction effect between gender and self-instructional learning strategy.

Discussion

The effectiveness of self-instructional learning strategy was demonstrated through significant improvement in the mathematical word problem solving performance of the students trained in it. The result of the data collected clearly shows that experimental group who were trained in self-instructional strategy achieved better than control group who were not trained. The analysis of hypothesis 1 using Two-way ANCOVA also showed a better academic achievement by the experimental group. Thus, self-instructional learning strategy seems to have contributed to the improvement of students' achievement in solving mathematical word problems.

The result of this study is, therefore, in agreement with previous research findings of Lang, Mastropieri, Scruggs, and Porter (2004) who presented evidence from studies on the effects of self-instructional training on algebra word problem solving performance of students with learning disabilities (LD), students for whom English is a second language (ESL) and students who were at risk of failing algebra. Results from the study indicated that the self-instruction group significantly outperformed the traditional instruction group on independent strategy use. Significant correlations were obtained between strategy usage and immediate and delayed posttest scores, indicating that students who successfully learned the strategy had better performance on solving math word problem tests.

Furthermore, other researches affirm the effectiveness of cognitive and metacognitive instruction strategy on students at-risk with Mathematics, while solving word problem Mathematics (Montague & Bos, 1986; Hutchison, 1993; Maccini & Hughes, 2000; Maccini & Ruhl, 2000; Gretchen, 2003; Montague, Enders & Dietz (2011). For instance, Montague, Enders, and Dietz (2011) engaged in a study to improve solving mathematical word problem for middle school students with learning problems by implementing Montague's Cognitive–Metacognitive instructional strategy in inclusive general education Mathematics classes. The findings were positive and support the efficacy of the intervention when implemented by general education math teachers in inclusive classrooms.

Moreover, it can be asserted that Montague's model used to teach self-instructional strategy was a practical and useful one. The findings are also in line with that of Gretchen (2003) who conducted a study on the effects of Montague's cognitive strategy instruction on the mathematical problem-solving performance of middle school students with learning disabilities (LD). The study assessed how participation in cognitive strategy instruction facilitated the students' knowledge, use, and control of mathematical problem solving strategies as well as how it affected two measures of motivation: students' ratings of self-efficacy in solving mathematical word problems and students' attribution of their effort in directing learning outcomes. Major findings of the study indicate that Montague's strategy instruction was efficacious in improving the mathematical word problem solving of students with learning disabilities.

Although other studies discussed above had few selected students with either learning disabilities, or at risk with Mathematics failure, the present study used students in intact classes which may not be true representative of the generalized effects of self-instruction on students with poor academic performance. It, nevertheless, confirmed the positive effect of self-instructional training on intact classroom performance. In conclusion, the present study demonstrated that self-instructional training provided students with a useful strategy (Modified version of Montague's model) for solving mathematical word problems.

A significant interaction effect between gender and learning strategy was also observed from this study following the analysis of hypothesis 2 using Two – way ANCOVA on the students' gain score in word problem mathematics achievement. Table 4 reveals that males trained in self-instructional learning strategy performed better than females trained in the same self-instructional strategy.

It is interesting to observe that prior to the training, the female in both experimental and control groups performed better than their counterpart male in both experimental and control groups as could be seen in the pretest scores. But then, the result of the Two-way ANCOVA analysis shows that there is no significant main effect of gender on mean gain score in word problem mathematics, $F(1,126) = .02$, $p<.902$. It means, therefore, that gender has no significant influence on the mean achievement of students in word problem mathematics. However, the post test score showed better performance of the experimental male group than their female counterparts and thereby confirming an interaction effect of gender and learning strategy.

The result of the present study is in consonance with previous research findings on the interaction effect of gender and learning strategy instruction. For instance, Kolawole (2008) noted a similar observation from research on the effects of competitive and cooperative learning strategies on Nigerian students' academic performance in Mathematics. The findings revealed that boys performed significantly better than girls in both learning strategies. This implies that there is positive significant interaction effect in favour of male students when instructional strategy intervention like self-instruction is given.

However, the finding of the present study contradicts the findings of Drzewiecki, and Westberg (1997) who carried out a survey on high school students to better understand how students' attitudes toward mathematics differ by gender and by group technique used in Mathematics instruction. The survey examined specifically the impact of cooperative grouping as an alternative to traditional mathematics instruction for improving females' attitude toward mathematics. A 2x2 analysis of variance indicated that there were no significant main effect for gender and instructional methods. The difference in the two results might be of the fact that the two researches focused on two different variables while considering the interaction of gender and instructional methods. As Drezewiecki, and Westberg (1997) targeted on females' students attitude toward Mathematics, the present study targeted on students' achievement in solving mathematical word problem using Montague's model.

The findings of this study and the discussions above confirm an interaction effect of gender and learning strategy in favour of experimental male students who performed better than the experimental female students. One possible explanation for the result obtained in this study in which the experimental male students performed better than their female experimental counterparts in solving word Mathematical problems is due to the strategy used. According to Fennema, Jacobs, Fran, and Levi (1998) the differences in strategy use by males and females in high school mathematics exert considerable influence on the disparity in their mathematics achievement. Gallergher and Lisi (1994) found that males were more unconventional in their problem solving strategy while females were more conventional. It is equally observed that males are more flexible and risk takers and therefore can easily try new strategies than females.

Consequently, the researcher concludes that male students perform better than female students when they are both exposed to self-instructional learning strategy.

Conclusion from the study

From the findings of this study, the following conclusions were made;

1. Self –instructional learning strategy which is student centred learning strategy that focuses on the monitoring of cognitive processes of a learner's problem solving, facilitated achievements in solving word problems in mathematics of students trained in it. Therefore, there was a significant difference in mathematical word problems achievements scores of students trained in self-instructional strategy than those that were not trained.

2. There is a significant interaction effect between gender and learning strategy of students trained in self-instructional strategy as male subjects achieved higher than the females.

Educational implications of the findings

The findings of this study have numerous implications: The study provides empirical evidence that self-instructional learning strategy can affect both cognitive and metacognitive domain of students while solving word problem in mathematics. Self-instructional strategy increased the student's problem solving skills leading to improvement on the academic achievement in word problem mathematics of students trained in it. Students should be actively involved in their learning processes since the activities they engage in the learning process affect their achievements as was the case in self-instructional strategy. This definitely makes them independent problem solvers.

Having seen the effect of self-instructional strategy on this population of students, it becomes imperative for teachers to model and use self-instructional strategies while instructing or doing their own studying. They should, therefore, focus not just on the contents of subjects but going further to assist students monitor their learning process. For further research, it is suggested that the study can be replicated in other science subject area.

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APPENDIX

Montague's Cognitive-Metacognitive Strategy for Mathematical Word Problem Solving

'Say-Ask-Check' Metacognitive Prompts Tied to a Word-Problem Cognitive Strategy		
Cognitive Strategy Step	Metacognitive 'Say-Ask-Check' Prompt Targets	Sample Metacognitive 'Say-Ask-Check' Prompts
1. **Read the problem.**	**'Say' (Self-Instruction) Target:** *The student reads and studies the problem carefully before proceeding.* ***'Ask' (Self-Question) Target:*** *Does the student fully understand the problem* ***'Check' (Self-Monitor) Target:*** *Proceed only if the problem is understood.*	**Say:** "I will read the problem. I will reread the problem if I don't understand it." **Ask: "**Now that I have read the problem, do I fully understand it" **Check:** "I understand the problem and will move forward."
2. **Paraphrase the problem.**	**'Say' (Self-Instruction) Target:** *The student restates the problem in order to demonstrate understanding.* ***'Ask' (Self-Question) Target:*** *Is the student able to paraphrase the problem* ***'Check' (Self-Monitor) Target:*** *Ensure that any highlighted key words are relevant to the question.*	**Say:** "I will highlight key words and phrases that relate to the problem question." "I will restate the problem in my own words." **Ask: "**Did I highlight the most important words or phrases in the problem" **Check:** "I found the key words or phrases that will help to solve the problem."
3. **Visualize** **'Draw' the problem.**	**'Say' (Self-Instruction) Target:** *The student creates a drawing of the problem to consolidate understanding.* ***'Ask' (Self-Question) Target:*** *Is there a match between the drawing and the problem* ***'Check' (Self-Monitor) Target:*** *The drawing includes in visual form the key elements of the math problem.*	**Say:** "I will draw a diagram of the problem." **Ask: "**Does my drawing represent the problem" **Check:** "The drawing contains the essential parts of the problem."
4. **HYPOTHESIZE**	**'Say' (Self-Instruction) Target:** *The student generates a plan to solve the*	**Say:** "I will make a plan to solve the problem."

Create a plan to solve the problem.	*problem.* ***'Ask' (Self-Question) Target:*** *What plan will help the student to solve this problem* ***'Check' (Self-Monitor) Target:*** *The plan is appropriate to solve the problem.*	**Ask:** "What is the first step of this plan What is the next step of the plan" **Check:** "My plan has the right steps to solve the problem."
5. **Predict/ estimate the Answer.**	**'Say' (Self-Instruction) Target:** *The student uses estimation or other strategies to predict or estimate the answer.* ***'Ask' (Self-Question) Target:*** *What estimating technique will the student use to predict the answer* ***'Check' (Self-Monitor) Target:*** *The predicted/estimated answer used all of the essential problem information.*	**Say:** "I will estimate what the answer will be." **Ask:** "What numbers in the problem should be used in my estimation" **Check:** "I did not skip any important information in my estimation."
6. **Compute the answer.**	**'Say' (Self-Instruction) Target:** *The student follows the plan to compute the solution to the problem.* ***'Ask' (Self-Question) Target:*** *Does the answer agree with the estimate* ***'Check' (Self-Monitor) Target:*** *The steps in the plan were followed and the operations completed in the correct order.*	**Say:** "I will compute the answer to the problem." **Ask:** "Does my answer sound right" "Is my answer close to my estimate" **Check:** "I carried out all of the operations in the correct order to solve this problem."
7. **Check the answer.**	**'Say' (Self-Instruction) Target:** *The student reviews the computation steps to verify the answer.* ***'Ask' (Self-Question) Target:*** *Did the student check all the steps in solving the problem and are all computations correct* ***'Check' (Self-Monitor) Target:*** *The problem solution appears to have been done correctly.*	**Say:** "I will check the steps of my answer." **Ask:** "Did I go through each step in my answer and check my work" **Check:** ""