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EFFECT OF SELF-REGULATED LEARNING STRATEGY ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN MATHEMATICS IN EZEAGU LOCAL GOVERNMENT AREA OF ENUGU STATE

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Abstract
This study was designed to investigate the effect of self-regulated learning strategy on secondary school students' achievement in mathematics in Ezeagu Local Government Area of Enugu state. It was a quasi-experimental study, pretest-posttest, non-equivalent groups were used. A total of 159 SSII students were sampled from two secondary schools in Ezeagu Local Government Area of Enugu state. The schools were made up of two rural and two urban schools drawn by purposive sampling while four intact classes were randomly sampled and assigned experimental and control groups. Mathematics Achievement Test (MAT) was used for data collection. The instrument was validated by the expert. A reliability coefficient of .83 was obtained for MAT using Kuder-Richardson's formula 20 (KR-20). Two research Questions and three hypotheses guided the study. MAT was administered to the subjects at the beginning of the study to collect the pretest achievement scores. After the treatment period of six weeks, MAT was administered to the subjects for posttest achievement scores. Mean and standard deviation were used to answer the research questions while the hypotheses were tested at .05 level of significance using Analysis of Covariance (ANCOVA). Major findings of the study revealed that students in the experimental group taught mathematics with self-regulated learning strategy achieved higher than those taught with lecture method. There was no significant effect or interaction between teaching methods and school location on students' academic achievement in mathematics. It was therefore recommended that self-regulated learning strategy should be adopted for teaching secondary school mathematics.

Keywords: Effect, Self-Regulated Learning Strategy, Secondary Education, Mathematics, Enugu State.

Introduction

According to Candy (2014), Self-regulated learning (SRL) is one of the domains of self-regulation, and is aligned most closely with the interests of teachers. Broadly speaking, it refers to learning that is guided by *metacognition* (thinking about one's thinking), *strategic action* (planning, monitoring, and evaluating personal progress against a standard), and *motivation to learn*. Self-regulated describes a process of taking control of and evaluating one's own learning and behavior Self-regulated learning emphasizes autonomy and control by the individual who monitors, directs, and regulates actions toward goals of information acquisition, expanding expertise, and self-improvement, (Candy, 2011).

Pintrich (2000) in Al-Gazir (2013) described self-regulated learning strategy as an active constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation and behaviour, guided and constrained by their goals and the contextual features in the environment. Hence, in self-regulated learning, students are actively involved and have clear intentions to be engaged in learning. There is also a purposeful focus of learning on the

achievement of a goal. Njor (2013) stated that a typical characteristic of self-regulated learners is that they use learning strategies to enhance their learning. Self-regulated learning is therefore a form of procedural knowledge; the 'the how' knowledge which when properly utilized can lead also to a conceptual knowledge, "the why" knowledge (Njor, 2013).

In particular, self-regulated learners are cognizant of their academic strengths and weaknesses, and they have a repertoire of strategies they appropriately apply to tackle the day-to-day challenges of academic tasks. According to Chung (2012), these learners hold incremental beliefs about intelligence (as opposed to entity, or fixed views of intelligence) and attribute their successes or failures to factors (e.g., effort expended on a task, effective use of strategies) within their control. Hence, students who are self-regulated learners believe that opportunities to take on challenging tasks, practice their learning, develop a deep understanding of subject matter, and exert effort will give rise to academic success. Gende (2012) held that these characteristics may help to explain why self-regulated learners usually exhibit a high sense of self-efficacy. Self-regulated learners, according to Gende, are successful because they control their learning environment. They exert this control by directing and regulating their own actions toward their learning goals. Clauss (2012) recommended that Self-regulated learning should be used in three different phases of learning. The first phase is during the initial learning, the second phase is when troubleshooting a problem encountered during learning and the third phase is when they are trying to teach others.

According to Ika (2013), there are three sources of self-regulated learning: active/executive, dynamic, and interest creating discovery model. Active/executive self-regulation is regulated by the person and is intentional, deliberate, conscious, voluntary, and strategic. The individual is aware and effortful in using self-regulation strategies. Under this source of SRL, learning happens best in a habitual mode of functioning. Dynamic self-regulation is also known as unintentional learning because it is regulated by internal subsystems other than the central executive. The learner is not consciously aware they are learning because it occurs "both under and outside the direct influence of deliberate internal control." The third source of self-regulated learning is the interest-creating discovery module, which is described as "bio-functional" as it is developed from both the active and dynamic models of self-regulation. In this model, learning takes place best in a creative mode of functioning and is neither completely person-driven nor unconscious, but it is a combination of both.

Candy (2014) asserted that Self-regulation from the social cognitive perspective looks at the triadic interaction among the person (e.g., beliefs about success), his or her behavior (e.g., engaging in a task), and the environment (e.g., feedback from a teacher). Candy also specified three important characteristics of self-regulated learning: 1) self-observation (monitoring one's activities); seen as the most important of these processes2) self-judgment (self-evaluation of one's performance) and 3). self-reactions (reactions to performance outcomes). To the extent that one accurately reflects on his or her progress toward a learning goal, and appropriately adjusts his or her actions to maximize performance, he or she has effectively self-regulated. Zimmerman (1989) in Banjo (2013) suggested that self-regulated learning process thrive better with three stages. The stages are:

1. Forethought, learners' preparing work before performance on their Social cognitive perspective Involving stages studying;
2. Volitional control, which is also called "performance control", occurs in the learning process. It involves learners' attention and will-power;
3. Self-reflection, happens in the final stage when learners review their performance toward final goals. At the same time, focusing on their learning strategies during the process is also efficient for their final outcomes.

Motivation plays a major role in self-regulated learning. Motivation is needed to apply effort and continue on when faced with difficulty. Control also plays a role in self-regulated learning as it helps the learner stay on track in reaching their learning goal and avoid being distracted from things that stand in the way of the learning goal. Banjo (2013) stated that there are three main areas of direct application of self-regulated learning in secondary schools and classrooms: literacy instruction, cognitive engagement, and self-assessment. In the area of literacy instruction, educators can teach students the skills necessary to lead them to becoming self-regulated learners by using strategies such as reciprocal teaching, open-ended tasks, and project-based learning. Other tasks that promote self-regulated learning are authentic assessments, autonomy-based assignments, and portfolios. These strategies are student-centered and inquiry based, which cause students to gradually become more autonomous, creating an environment of self-regulated

learning. However, students do not simply need to know the strategies, but they need to realize the Application in practice and the importance of utilizing them in order to experience academic success.

According to Banjo Students' use of learning strategies – and their continued use of them in the face of difficulty – is based on the beliefs that these strategies are necessary for learning, and that they are effective ways of overcoming obstacles. Hameed (2013) added that students who are not self-regulated learners may daydream, rarely complete assignments or forget assignments completely. Conversely, those who do practice self-regulation ask questions, take notes, allocate their time effectively, and use resources available to them. According to Hameed, self-regulation behaviors include, but are not limited to, the following: finishing homework assignments by deadlines, studying when there are other interesting things to do, concentrating on school subjects, taking useful class notes of class instruction, using the library for information for class assignments, effectively planning schoolwork, effectively organizing schoolwork, remembering information presented in class and textbooks, arranging a place to study at home without distractions, motivating oneself to do schoolwork, and participating in class discussions.

Kendy (2014) listed ways a teacher can train his student on self-regulated learning thus:

i. **Self-Assessment**: fosters planning, assess what skills the learner has and what skills are needed. Allows students to internalize standards of learning so they can regulate their own learning.
ii. **Wrapper Activity**: activity based on pre-existing learning or assessment task. This can be done as a homework assignment. Consist of self-assessment questions to complete before completing homework and then after completion of homework. This will allow the learner to draw their own conclusions about the learning process.
iii. **Think Aloud**: This involves the teacher describing their thought process in solving a problem. **Questioning**: Following new material, student develops questions about the material.
iv. **Reciprocal Teaching**: the learner teaches new material to fellow learners.

According to Murphy (2013), self-regulation unfolds over "four flexibly sequenced phases of recursive cognition." These phases are task perception, goal setting and planning, enacting, and adaptation. During the task perception phase, students gather information about the task at hand and personalize their perception of it. This stage involves determining motivational states, self-efficacy, and information about the environment around them. Next, students set goals and plan how to accomplish the task. Several goals may be set concerning explicit behaviors, cognitive engagement, and motivation changes. The goals that are set depend on how the students perceive the task at hand. The students will then enact the plan they have developed by using study skills and other useful tactics they have in their repertoire of learning strategies. The last phase is adaptation, wherein students evaluate their performance and determine how to modify their strategy in order to achieve higher performance in the future. They may change their goals or their plan; they may also choose not to attempt that particular task again. Murphy state that all academic tasks encompass these four phases. Hence, these four phases of self-regulated leaning are deemed adequate for this study.

Njor (2013) stated that a typical characteristic of self-regulated learners is that they use learning strategies to enhance their learning. Self-regulated learning therefore a form of procedural knowledge; the 'the how' knowledge which when properly utilized can lead also to a conceptual knowledge, "the why" knowledge (Njor, 2013). There is no doubt that self-regulated learning strategy can facilitate learning and enhance secondary school students' academic achievement. However, research evidences have reported conflicting findings on the effect of self-regulated learning on students' achievement and interest in secondary school subject. While Jegede (2012) and Banjo (2013) found that self-regulated learning strategy promoted secondary school students' achievement and interest, Chung (2012) and Hameed (2013) found the contrary. This gap of no definitive conclusion justifies the need for more studies such as this present work.

Purpose of the Study

The purpose of this study was to find out the effect of self-regulated learning strategy on secondary school students' achievement in mathematics in Ezeagu Local Government Area of Enugu state. Specifically, the study aimed at;

i. secondary school students' achievement in mathematics
ii. secondary school students' achievement in mathematics with regard to their gender.

Research Questions

The following research questions guided the study;

1. What are the mean achievement scores of students in the experimental and control groups in both pretest and posttest?
2. What are the mean achievement scores of male and female students in the experimental and control groups in both pretest and posttest?

Hypotheses

The following hypotheses were tested at .05 level significance;

1. There is no significant difference between the mean achievement scores of the students in the experimental and control groups.
2. There is no significant difference between the mean achievement scores of male and female students in both experimental and control groups.
3. There is no significant interaction between method and gender on students' achievement in mathematics.

Methodology

The research design adopted in the conduct of this investigation was quasi-experimental design, thus, a pre-test–posttest, non-equivalent groups design was used. Intact classes randomly assigned to experimental and control groups were used. This justifies the choice of this research design as the researchers could manipulate the subjects by way of assigning them randomly to either experimental or control groups. The area covered in this study was Ezeagu Local Government Area of Enugu State.

The population of the study consisted of all senior secondary two (SSII) students in public secondary schools in Ezeagu Local Government Area of Enugu State, numbering 8,705 students as at the time of this study. From this population, two schools were randomly sampled. In each of the two secondary schools two SSII intact classes were sampled randomly and consequently assigned experimental and control groups randomly also. The total number of 159 students in the four SSII intact classes described above constituted the subjects of the study. 81 students out of the sample belonged to the experimental group while 78 were in the control group. Also the sample was made up of 65 males and 94 females. Mathematics Achievement Test (MAT) was developed by the researcher and used for data collection in the study. MAT was made up of 40 – items with 4 options each. Mathematics Achievement Test (MAT) was validated by three research experts. MAT was trial-tested by administering it to SSII Students in a different school outside the education zone used for the study. The scores obtained were used to compute a reliability of .83 for the instrument using Kuder-Richardson's formula 20 (KR-20). Research Questions were answered using mean and standard deviation while test of hypotheses was done with Analysis of Covariance (ANCOVA) at .05 level of significance.

Experimental procedures

The researchers trained the four regular mathematics teachers in the four secondary schools used in the study for a period of two weeks on the use of divide-and conquer problem solving strategy. At first, the MAT was administered to all the subjects of the study as pre-test. Thereafter, the treatment was administered for a period of six weeks. The experimental group in each school was taught basic technology using the divide-and conquer problem solving strategy, while the control group in each school was taught the same topics using lecture method. At the expiration of the treatment period, the MAT was re-administered to all the subjects as posttest.

Results

Research Question 1

What are the mean achievement scores of students in the experimental and control groups in both pretest and posttest?

Table 1: Mean achievement scores and standard deviation of the students in experimental and control groups in pretest and posttest.

Group	**n**	**Pretest Mean**	**SD**	**Posttest Mean**	**SD**
Experimental	81	40.0	3.13	84.5	0.33
Control	78	39.9	3.14	49.8	3.11

From table 1 above the pretest mean score of experimental group was 40.0 while that of control group was 39.9. These suggest that both groups were almost of equal ability at the beginning of the experiment. In the posttest experimental group had a mean of 84.5 while the control group had a mean of 49.8. Apparently, the two groups achieved higher in the posttest than the pretest indicating that learning took place. However, the posttest mean score of the experimental was higher than that of the control group. Moreso, a lower standard deviation value of 0.33 in the posttest for experimental group indicates that there were fewer extreme scores in the experimental group than the control.

Research Question 2

What are the mean achievement scores of male and female students in the experimental and control groups in both pretest and posttest?

Table 2: Mean achievement scores and standard deviation of male and female students in experimental and control groups in pretest and posttest.

Group	**n**	**Pretest Mean**	**SD**	**Posttest Mean**	**SD**
Male (Experimental)	31	39.6	3.01	92.0	0.28
Male (Control)	34	37.9	3.12	49.5	3.44
Female (Experimental)	50	40.2	3.10	77.0	0.31
Female (Control)	44	41.0	3.13	49.9	3.01

From table 2 above the posttest mean score of the male (experimental) was 92.7 while that of female (Experimental) was 77.0. Similarly, the posttest mean score of the male (control) was 49.5 while that of female (Control) was 49.9. This result suggests that both experimental groups (male and female) achieved equally and both control groups.

Hypotheses

1. There is no significant difference between the mean achievement scores of the students in the experimental and control groups.
2. There is no significant difference between the mean achievement scores of male and female students in both experimental and control groups.
3. There is no significant interaction between method and gender on students' achievement in mathematics.

Table 3: ANCOVA Analysis of Students' Mean achievement scores.

Source of variation	Sum of squares	DF	Mean Squares	F- Calculated	Sig.	Decision
Covariates	6807.490	1	6807.490		.000	
Method	7.197	1	7.197	0.6369	0.000	S
Gender	41.658	1	41.658	3.6868	0.016	S
Interaction (Method* Gender)	55.177	1	55.177	4.883	0.411	S
Residual	1751.352	155	11.2990			
TOTAL	**8662.874**	**159**				

S = Significant, NS = Not Significant at .05 level of probability.

Method as main effect gave an f value of 0.6369 and this is significant at 0.000. Since 0.000 is less than 0.6369 this means that at .05 level of significance, the f value of 0.6369 is significant. Therefore, hypothesis 1 is rejected as stated. This indicates that there is significant difference between the mean achievement scores of the students in the experimental and control groups. Gender as main effect gave an f

value of 3.6868 and this is significant at 0.016. Since 0.0.016 is less than 3.6868 this means that at .05 level of significance, the f value of 3.6868 is significant. Therefore, hypothesis 2 is rejected as stated. This indicates that there is significant difference between the mean achievement scores of male and female students in both experimental and control groups.

Main interaction (Method*Gender) as main effect gave an f value of 4.883 and this is significant at 0.411. Since 0.411 is less than 4.883 this means that at .05 level of significance, the f value of 4.883 is not significant. Therefore, hypothesis 3 is not rejected as stated indicating that there is significant interaction between method and gender on students' achievement in mathematics.

Summary of Findings

The results as presented revealed the following:

1. The students of self-regulated training achieved higher in mathematics than their counterparts who had no self-regulated training.
2. The mean achievement scores of male and female students taught with self-regulated learning strategy differed significantly in favour of the male students.
3. Interaction effect between teaching strategies and gender of students in students' achievement in mathematics was significant.
4. Male students taught mathematics with self-Regulated learning strategy achieved higher than their female counterparts, indicating that self-Regulated training is likely to favour the male students more than female students.
5. Efficacy of self-Regulated learning strategy may be determined by gender of the students.

Discussions

From table 1, the experimental group had a higher mean achievement score than the control group. This finding is in agreement with the findings of Candy (2011), Clauss (2012) and Gende (2012) who submitted that self-regulated learning is a strategy in which students are able to learn by personally and socially constructing knowledge, hence, it gives the students control over his learning. It is obvious that learning is a search for meaning. Therefore, learning must start with the issues around which students are actively trying to construct meaning. Also meaning requires understanding wholes as well as parts. And parts must be understood in the context of wholes. Therefore, the learning process focuses on primary concepts, not isolated facts. In order to teach well, we must understand the mental models that students use to perceive the world and the assumptions that make to support those models. All these are attributes of self-regulated learning strategy.

The result in table 3shows that there was significant difference between the mean mathematics achievement scores of male and female students taught mathematics with self-regulated learning strategy. Consequently, the interaction effect between teaching strategy and students gender was very significant. All these indicate that male students out performed their female counterparts in the self-regulated learning class. This result supports the findings of Murphey (2013) and Hameed (2013) who in their separate studies found students gender as a determinant of students' academic achievement. Conversely, the finding disagrees with the findings of Nneji & Anyafulude (2014) who found that students gender had insignificant influence on their academic achievement. It is therefore obvious that experimenters' ingenuity in controlling extraneous variables may have informed the conflicting findings

Conclusion

Based on the findings stated above, the following conclusions were made:

Self-regulated learning strategy elicits higher achievement in mathematics among secondary school students.

Recommendations

Consequent upon the findings of this study, the following recommendations were deemed necessary;

1. Self-regulated learning strategy should be used in teaching mathematics in senior secondary schools.
2. Mathematics teachers should be trained adequately on the use of self-regulated learning strategy.

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