META-COGNITIVE LEARNING STRATEGY COMPONENTS AS PREDICTORS OF SECONDARY SCHOOL STUDENTS' MATHEMATICS LEARNING IN BENIN CITY

Judith Hannah Osarumwense

Abstract

This study focused on how critical thinking, self regulation, self assessment and effort management predict academic achievement in mathematics. One research question was raised and two hypotheses formulated. It was a correlation research design study. The population was SS2 students in Benin City. A sample size of 140 students and Simple random sampling technique were used. Mathematics Meta-Cognitive Learning Strategies Scale (MM-CLSS) was used for data collection. The reliability coefficients of .76, .70, .75 and .86 were obtained for 4 scales respectively and .90 for the entire scale. The instrument addressed the interest of the study. Also, the mathematics scores of the students for the 2018/2019 third term examination were standardized with Z and T scores to allow for comparison from one school to the other. Data from the instrument and mathematics standardized scores were subjected to statistical analyses. The research question was answered using basic statistics while linear regression was employed to test hypotheses 1 and 2. Findings show that students make use of meta-cognitive learning strategies except self-regulation. Achievement in mathematics was insignificantly accounted for by meta-cognitive components and there was a significant differential prediction by sex. It was recommended that students should be encouraged to make use of self-regulation strategy to improve learning.

Keywords: Meta-cognitive learning strategies, Mathematics, Academic performance, Senior secondary school students, Linear regression.

Introduction

The language of science and technology is mathematics. Without it, students will find it difficult to easily learn science and its related subjects. Mathematics, according to Salman, Mohammed, Ogunlade and Ayinla (2012), is the science of numbers and space as well as the language used in science and technology. Because of its importance, mathematics is required in all aspects of human development such as economics, politics, geography, science and technology. The subject domiciles mainly in statistics, accounts, Arithmetic, engineering.

Fafunwa in Maliki, Ngban and Ibu (2009) revealed in their research study that, 'everyone lives in a world where science and technology have become an integral part of world culture. For any nation to be relevant, the role mathematics plays in the educational system must not be underrated' (p.131). Nevertheless, reports made on yearly basis on academic achievement of students in mathematics reflect students' low performance at both internal and external examinations (Ashiaka, 2010). A study conducted by Maduabum and Odili (2006) indicated a low achievement in mathematics. According to the study, Nigerian students who wrote mathematics examinations conducted by WAEC from 1991 to 2002 had below 38% credit pass. Achor, Imoko and Jimin (2012) noted that the WAEC chief examiner for 2005 mathematics lamented the poor achievement of students in the subject and pointed out that it might reduce their interest in the subject.

Academic achievement in mathematics cannot be enhanced without effective learning strategy. Learning, according to Lexico (2019) is the acquisition of knowledge or skills through study, experience or being taught. Sharma (nd) defines learning as a relatively permanent change in behaviour that occurs as a result of practice and experience. For effective study to take place, students have their role to play by strategizing different plans of action in order to bring about change in the rate of understanding. Thus, Thompson and Mascazine in Osarumwense (2015) noted that students who accept responsibility for their learning, utilize various methods to enhance their learning styles. Plans put in place to enhance effective learning are termed learning strategies.

Learning strategies refer to students' self-generated thoughts, feelings, and actions which are systematically oriented toward the attainment of their goals (Hasanbegovic, 2016). Schumaker and Deshler in Freeman (2004) defines learning strategy as an individual's approach to complete a task or an individual's way of organizing a set of skills more effectively to learn content or accomplish tasks in academic or non-academic settings. Learning strategies, according to Instructional Design.org (2018), are methods that students use to learn. They range from techniques for improved memory to better studying or test-taking strategies. Freeman (2004) affirmed that learning strategies can improve students' performance in inclusive settings or on grade appropriate tasks.

Among the learning strategies identified by researchers, cognitive and meta-cognitive learning strategies are commonly featured. For example, Liu and Lin (2010) classified learning strategies into four categories: cognitive, meta-cognitive, informational resources management and non informational resources management. Osarumwense (2015) classified them into three categories: cognitive, meta-cognitive, learning resources management. Between the two commonly identified learning strategies:

cognitive and meta-cognitive, Metalhdou and Viachou (2007) found that meta-cognitive strategies enhance the performance of students better than cognitive strategies. The learning strategies employed by students can provide evidence about the mathematics skills they will acquire and their attitude towards learning which will also determine their level of achievement in mathematics. To Rotgans (2009), better academic performance is as a result of students engaging in deeper processing of information which is usually influenced by positive learning strategies and the high motivation of students towards learning. Stein, Grover and Henninssen in Fajemidagba, Salman and Ayinla (2012) noted that the use of enhanced instructions can improve students' ability to engage in critical mathematics reasoning. Critical reasoning is a component of meta-cognitive learning strategy which deals mainly with how to understand mathematical concepts. Meta-cognitive learning is geared towards making effort to enhance the learning process.

Abedi (2011) noted that students that have never learned how to learn are ones having problems with learning. Learning to learn is called meta-cognition. Meta cognition is thinking in an advanced way, thinking about thinking and learning how to learn (Abedi, 2011). McGregor and Schoenfeld in Tien (2013) observed that college students that are ill prepared usually do not know how to acquire and process information or direct their learning in the ways they will be productive. Meta-cognitive skills according to Yang and Lee (2000) involve monitoring and selecting various learning decisions and strategies. For students to successfully learn mathematics they should be able to monitor or make decisions about learning. Students that are not good in the use of meta-cognitive skills always have difficulty with mathematics (Skroll & Miller in Yang & Lee, 2000). Studies have shown that students can learn the use of meta-cognitive skills to enhance their learning. Students who utilize higher meta-cognitive abilities perform better in mathematical problem solving than those who do not because they outline plans to arrive at solutions before they start solving any given problems. When they become confused as they solve problems, they tend to reflect, select and use alternative methods. Osarumwense (2015) classified meta-cognitive strategies into critical thinking, self-regulation, effort management and self-assessment.

Critical Thinking according to Liu and Lin (2010) refers to the 'strategies to make purposeful or reflective judgment or decisions by analysing the information observed' (p. 223). Critical thinking is utilized when students are able to engage in meaningful learning and effectively transfer knowledge from one setting to another. Dartmouth (2012), knowing the importance of critical thinking, noted that students should not directly jump to “number crunching” without ensuring that they have successfully analysed the logic of the problem. Students end up with counter-productive effects when they unnecessarily jump into solving mathematics problems without thinking. On the other hand, students end up getting incorrect answers when they compute carelessly even when they analyse the problem before solving.

Self-regulation is another component of meta-cognitive strategy that is very important for goal actualization. Bodrova, Germroth and Leong (2013) described self-regulation as the ability of an individual to control his or her impulses in order to be able to stop or start doing something when necessary. For students to maximize the achievement of their goals and regulate their conditions of learning, they must critically examine the learning styles and strategies that enhance their learning. Students understand themselves better and know the best way to learn. This enables them to strategize for the best ways to learn. Zimmerman and Campillo, (2003), Cleary and Zimmerman (2004) noted that learners who are mindful and confident, set goals and work towards their realization. They are learners that have high self-regulated approach towards learning.

Effort management is the willingness to exert oneself to channel ones' ability to perform an identified task. Effort management is the personal organizational zeal an individual puts into a given task to succeed. Chen (2002) affirmed that students that are able to withstand failure and setbacks are those that have effort management skills and are usually able to focus on the learning task and ignore distractions. Pintrich and Schunk in Altun and Erden (2013) emphasized that individual who end up performing tasks as planned are those who successfully utilize effort regulation strategy. Effort management according to Liu and Lin (2010) 'reflects the commitment to complete ones goal'. Doljonac in Altun and Erden (2013) noted that successful academic achievement is strongly determined by the ability of the individual to regulate his or her effort.

Self-assessment is a learning strategy in which an individual reflects on how well he or she has benefited from the learning exercise. Students' self-assessment could mean the gathering of information about the process of learning, reflecting on how well one has learnt, getting feedback about personal progress, skills acquired, processes and attitudes towards learning. 'Self-assessment leads a student to a greater understanding of self as a learner' (Ministry of Education, 2002). Mcmillan and Hearn, (2008) define self-assessment as a means by which students identify the strategies that can aid their comprehension and an ability to follow up and assess their thinking level as well as the behaviour they exhibit while learning. Students improve on their performance and are motivated to learn more when there is improvement in the level of their understanding based on attainment of set goals. They verify their learning effectiveness and generate strategies for more learning (Mcmillan & Hearn, 2008).

Chappins and Stiggins (2002) noted that students' self-assessment significantly impacted on their academic achievements as they are personally involved in the assessment process. This enables them to set higher goals and work more to attain them. Mcmillan and Hearn (2008) noted that students greatly benefit from the learning tasks whenever they explain their own work and examine their learning outcomes by reflecting on and identifying their strengths or weaknesses. This creates deeper understanding rather than superficial knowledge. Rolheiser, Bower and Stevahn, (2000) described reflection as an essential aspect of effective self-assessment. It occurs when students think of how their work meets set criteria, how they analyse the effectiveness of their efforts, and plan for greater achievements. Mcmillan and Hearn (2008) affirmed that meta-cognition can be enhanced when reflective processes are developed.

Sex differences in learning strategies have been a major concern in mathematics learning. Altun and Erden (2013) found that there are differences in the strategies of learning and how students benefit from learning based on sex. Peklaj and Pecjak (2002) found that female students used self-regulation in learning mathematics more than male students. Iri (2013) discovered that the meta-cognitive knowledge of female students is significantly higher than that of their male counterparts. Zhu (2007), however, noted that literature supports that male students are better skilled in problem solving than female students.

Arani and Mobarakeh (2012) found no significant difference by sex in the use of meta-cognitive strategies except that they differ in the usage of logical/mathematical intelligence as males had a higher performance in the application of mathematical intelligence. Chen, Ferron, Gorin and Thompson (2005) found a significant difference by sex in logical reasoning. Male students demonstrated higher performance in logical reasoning while female students demonstrated greater mastery of questions that deal with 'evaluate and verify'. However, they found minimal impact of sex differences in the mathematics skills of students. Performance Institute of Students Assessment (2003) also found remarkable differences in the way students enjoy studying Mathematics, their self-related belief, as well as the emotions and learning strategies they exhibit in studying the subject.

Chen, et al (2005) found a significant sex difference in meta-cognitive self-regulating use of students, amount of time spent by them, how they manage the environment where they study, how they regulate their effort, seek for help and their perception of their self-efficacy. They, however, noted that self-regulation, time and learning' environment management, perception about self efficacy significantly predicted boys mathematics achievement whereas the way students regulate their effort alone statistically predicted girls mathematics achievement.

Mathematics has been a problem to many students. The performance of students in mathematics for some years now has been very discouraging. This is evident in the percentage performance of students who made A_1-C_6 from year 1991 to year 2016. For over 26 years, it was only in 2004 that students' percentage performance in mathematics rose up to 53.80%. Surprisingly, 0.00% to 10.00% of students fell within A_1-C_6 in 1997, 1999 and 1996. In other years, students had less than 50.00% performance in the subject (Zalmon & Wonu, 2017). Researchers have proven that meta-cognitive learning strategies enhance students' achievement in mathematics. Skroll and Milier in Yang and Lee (2000) found that students who are not good in the use of meta-cognitive skills always have difficulty with mathematics while those who utilize strong meta-cognitive abilities perform better in mathematical problem solving. Since researchers have found meta-cognitive learning strategy an essential tool for success in mathematics, one wonders if secondary school students do not make use of the strategy in studying mathematics. Thus, the researcher deemed it necessary to investigate if students reasonably make use of the strategy in studying mathematics as well as to find the prediction of the components of meta-cognitive learning strategies on students' achievement in mathematics. Thus, the objectives of this study are to

1. assess secondary school students' level of usage of meta-cognitive learning strategy components to enhance their achievement in mathematics;
2. determine meta-cognitive learning strategy components prediction of students' achievement in mathematics; and
3. assess differential prediction of meta-cognitive learning strategies of students on their mathematics achievement by sex.

Research Question

The following research question was raised to guide the study:

1. What is the level of secondary school students' use of meta-cognitive learning strategy components to enhance their achievement in mathematics?

Research Hypotheses

Two hypotheses were formulated for the study

1. Meta-cognitive learning components do not significantly predict students' achievement in mathematics.
2. There is no significant difference in meta-cognitive learning strategies' prediction of male and female students' mathematics achievement.

Methods

The study made use of correlation research design approach. All senior secondary school 2 students in Benin City made up the population of the study. A sample size of 140 students was used. Simple randomly sampling technique was used to select the seven (7) schools from the city. Twenty students (10 males and 10 females) were randomly selected from the seven (7) schools which gave a total of 140 students. Mathematics Meta-Cognitive Learning Strategies Scale (MM-CLSS) which was developed by Osarumwense (2015) was adopted for data collection. The reliability of the instrument was .90 which shows that the instrument was highly reliable. The instrument consisted of two sections. The first section sought demographic data such as name of school, sex, identification code to enable the researchers identify the mathematics scores of students while the second section was based on 38 items addressing the interest of the study. Also, the mathematics scores for the 2018/2019 third term examination were collected from the vice principals of the schools used and the scores were standardized using Z and T scores to allow for comparison of schools. The data generated from the instrument and mathematics standardized scores were subjected to statistical analyses. Hypothesis 1 was tested using one sample t-test while hypotheses 2 and 3 were tested using linear regression.

Results

Research Question 1: What is the level of secondary school students' use of meta-cognitive learning strategy components to enhance their achievement in mathematics?

Table 1: Mean Description of the Level of Usage of Meta-Cognitive Learning Strategy Components

	Number	Mean	Std	Test Value	Decision
Critical Thinking	2100	3.011	0.97191	2.5	High
Self Regulation	700	2.4229	1.0863	2.5	Low
Self Evaluation	840	2.8083	1.0335	2.5	High
Effort Management	1680	3.3857	0.7362	2.5	High

From Table 1, the approximate mean scores of 3.01, 2.42, 2.81 and 3.39 and approximate standard of .97, 1.09, 1.03 and .74 were obtained for critical thinking, self-regulation, self-evaluation and effort management respectively. The mean scores of critical thinking, self evaluation and effort management were higher than the test value of 2.5. On the other hand, the mean score of 2.42 which was less than the test value of 2.5 was obtained for self-regulation. It therefore means that secondary school students used of critical thinking, self-evaluation and effort management to enhance their mathematics learning. However, they did not regulate themselves in studying mathematics. The students managed their efforts most in studying the subject followed by in critical thinking and self-evaluation but did not regulate themselves in studying the subject.

Test of Hypotheses

Hypothesis 1: Meta-cognitive learning components do not significantly predict students' achievement in mathematics.

Table 2 a: Model Summary of Regression Analysis of the Pr ediction of Meta-Cognitive Learning Strategy Components on the Students' Mathematics Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	390.407	4	97.602	.353	.841[b]
1	Residual	33408.704	121	276.105		
	Total	33799.111	125			

a. **Dependent variable; Students' Mathematics Performance.**
b. **Predictors; (constant), Meta-cognitive Learning Strategy components.**

In Table 2a, a p-value of .841 which is greater than .05 α level of significance was obtained. It means that the meta-cognitive learning strategy components did not significantly contribute to academic performance of students in mathematics.

Table 2 b: Parameter Estimates of Regression Analysis of the Prediction of Meta-Cognitive Learning Strategy Components on the Students' Mathematics Performance

Model	Unstandardized Coeffs B	Standardized Coeffs Std Error	Beta	R	R-Sq	Adj R-Sq
Constant	52.074	11.067				
1 Critical Thinking	.038	.320	.014			
Self Regulation	-.222	.216	-.095	.107[a]	.012	-.021
Self Evaluation	-.221	.450	-.055			
Effort Management	.061	.200	.033			

a. **Dependent Variable; Students' Mathematics Performance**

Table 2b revealed that the R Square is .012. This means that 1.2% of the dependent variable (students' mathematics performance) was explained by the predictors (meta-cognitive learning strategy components). The constant term was approximately 52.1 and the predictor (meta-cognitive learning strategy components) were approximately .038, -.222, -.221 and .061 for critical thinking, self-regulation, self-evaluation and effort management respectively. The value of r, which is approximately .11, represents the correlation between the meta-cognitive learning strategy components and academic performance of students in mathematics. In Table 2a, p-value of .841 which is greater than .05 α level of significance was obtained. It therefore means that the meta-cognitive learning strategy components did not significantly contribute to academic performance of students in mathematics. It shows that some other variables that were not studied contributed significantly to students' academic performance.

The regression equation is $Y_1 = X_i + C_1$

Therefore, $Y = .04X_1 - .22X_2 - .22X_3 + .06X_4 + 52.1$, where Y is the students' mathematics performance and the X is the meta-cognitive learning strategy components.

Hypothesis 2: There is no significant differential prediction of meta-cognitive learning strategies of students to their mathematics achievement by sex.

Table 3a: Male Students' Model Summary

Model	R	R-Square	Adjusted R Square	Std. Error of Estimate.
.186[a]		.035	-.048	19.17540

a. Predictors: (Constant), Male Meta-Cognitive Learning Strategy Components

Table 3a revealed that the R Square was .035 and the standard error of estimate ($SE_{1)}$ was approximately 19.18. The implication of this result is that only 3.5% of the male students' performance (dependent variable) was explained by the male meta-cognitive learning strategy components (independent variables).

Table 3 b: Male Students' Regression Coefficients of the Prediction of Me ta-cognitive Learning Strategy Components on the Students' Mathematics Performance

Model	Unstandardized Coeffs		Standardized Coeffs	t	Sig.(2tailed)
	B	Std Error	Beta		
1. Constant	40.563	18.180		2.231	.030
Critical Thinking	.440	.551	.160	.800	.428
Self Regulation	.539	.769	.117	.702	.486
Self Evaluation	-.822	.798	-.204	-1.030	.308
Effort Management	.032	.287	-.019	-.110	.913

a. **Dependent variable; Male Students' Mathematics Performance**
b. **Predictor variables; Male Meta-cognitive Learning Strategy Components**

Table 3b revealed that the approximate constant term was 40.6 and the predictor variables were approximately .44, .54, -.82 and -.03. The regression equation is:

$Y_1 = .44X_1 + .54X_2 - .82X_3 - .32\ X_4 + 40.6$................................ (1),

Where Y_1 is the dependent variable (male students' performance) and the X is the predictor variables

Table 3c: Female Students' Model Summary

Model	R	R-Square	Adj R-Square	Std. Error of Estimate.
	.207[a]	.043	-.004	14.05280

a. Predictors: (Constant), Female Meta-Cognitive Learning Strategy Components

Table 3c revealed that the R Square was .043 and the standard error of estimate (SE2) was approximately 14.05. This implies that only 4.3% of the female mathematics performance (dependent variable) was explained by the female meta-cognitive learning strategy components (independent variables).

Table 3d: Female Students' Regression Coefficients of the Prediction of Meta-Cognitive Learning Strategy Components on the Students' Mathematics Performance

Model	Unstandardized Coeffs B	Std Error	Standardized Coeffs Beta	t	Sig.(2tailed)
1. Constant	51.069	12.450		4.102	.000
Critical Thinking	-.288	.336	-.123	-.857	.394
Self Regulation	-.283	.193	-.161	-1.469	.146
Self Evaluation	.039	.484	.010	.080	.937
Effort Management	.342	.278	.158	1.229	.223

a. **Dependent variable; Female Students' Mathematics Performance**
b. **Predictor Variables; Female Meta-cognitive Learning Strategy Components**

In Table 3d, the constant term was approximately 51.07 and the coefficients of the independent variables were -.288, -.283, .039 and .342. The equation of regression is

$Y_2 = -.288X_1 - .283X_2 + .039X_3 + 342X_4 + 51.069$ .... (2),

Where Y_2 is the dependent variable (female students' performance) and the X_i is the predictor variables (female meta-cognitive learning strategy components)

Comparing equations (1) and (2), the predictors in equation (1) were .44, .54, -.82 and -.03 while those of equation (2) were -.288, -.283, .039 and .342. The constant terms of equations (1) and (2) were 40.563 and 51.069 respectively. The implication of these results is that the two equations are both gradient and intercept biased since their gradients and intercepts are not the same. Hence, there was differential prediction between male and female students' meta-cognitive learning strategies on their mathematics achievement

Table 3a shows that male standard error of estimate (SE_1) was 19.18 while Table 3c revealed that the female standard error of the estimate (SE_2) was 14.05.

$$(SE_1)^2 = (19.18)^2$$
$$= 367.8724$$
$$(SE_2)^2 = (14.05)^2$$
$$= 197.4025$$
$$F_{cal.} = (SE_1)^2 \div (SE_2)^2$$
$$= (367.8724) \div (197.4025)$$
$$= 1.8636 \text{ which approximates } 1.86$$

F_{tab} at $p = .05 = 1.43$, $df_1 = 51 - 2 = 49$ and $df_2 = 85 - 2 = 83$.

Since $F_{cal} > F_{tab,}$ there was a significant differential prediction of male and female students' meta-cognitive learning strategies on their mathematics achievement. Hence, the null hypothesis was not retained.

Discussion

Findings show that secondary school students significantly used critical thinking, self-evaluation and effort management to enhance their mathematics learning. However, they did not significantly regulate themselves in studying mathematics. Secondary school students in Benin City mainly used critical thinking, self-evaluation and effort management of meta-cognitive learning strategies to enhance their mathematics learning without sufficiently making use of self-regulation strategies. This could be the reason they often performed poorly in mathematics over the years. Pintrich and DeGroot (1990) found that the use of good cognitive strategy and self-regulation (meta-cognitive) highly relates to academic gains of students and that poor performance of students is usually as a result of the students not using high self-regulatory strategies. Supporting this claim, Altun and Erden (2013) discovered that mathematics achievement is greatly influenced by students' meta-cognitive self-regulation, regulation of time and study environment.

It was also found in this study that the meta-cognitive learning strategy components did not significantly contribute to the dependent variable. This means that the predictive variables together did not significantly predict achievement of students in mathematics. Therefore, other variables (constant) which were not studied much have contributed to achievement. These could be intelligence, teacher's factor and emotions. Schunk in Liu and Lin (2010) pointed out that there are so many factors that may influence the learning of students such as the method of teaching used by the teachers, students' learning environment, the learning strategies employed by students and the level of motivation of the students. He however emphasized that motivation and learning strategies employed by students are of paramount importance.

The findings of this study also show that there was a significant differential prediction of male and female students' meta-cognitive strategies of learning on their mathematics achievement. Altun and Erden (2013) corroborate this finding in their discovery that students' learning strategies differ based on sex as well as how they benefit from learning. Peklaj and Pecjak (2002) found that female students use self-regulation component of the meta-cognitive strategies more than male students in learning mathematics. Iri (2013) observed that the meta-cognitive knowledge of female students is significantly higher than that of their male counterparts. Performance Institute of Students Assessment (PISA) (2003) also noted remarkable differences in the way students enjoy studying mathematics, their self-related belief, as well as the emotions and learning strategies they exhibit while studying mathematics. Chen et al (2005) found a significant sex difference in the use of meta-cognitive self-regulation, amount of time spent by students, how they manage the environment they study, how they regulate their effort and seek for help, and their perception about their self-efficacy.

Contrary to the finding of this study, Arani and Mobarakeh (2012) discovered that there is no significant difference by sex in the use of meta-cognitive strategies except for the fact that they differ in the usage of mathematical intelligence. To them, intelligent mathematics students and those that reason mathematics logically use more meta-cognitive strategies in solving mathematics problems. That learning process is influenced by the differences that exist between male and female students.

Conclusion

It can be concluded that secondary school students significantly make use of critical thinking, self-evaluation and effort management but did not make use of self-regulating meta-cognitive learning strategy in studying mathematics to any significant level. Also, meta-cognitive learning strategy components did not significantly contribute to academic performance of students in mathematics. There was a significant differential prediction of male and female students' meta-cognitive learning strategies in their mathematics achievement.

Recommendations

Based on the findings of this study, it was recommended that:

1. Students should be encouraged to use self-regulating learning strategy to enhance their mathematics learning.
2. Students should be encouraged to engage in deeper critical thinking that will yield excellence in mathematics learning.
3. Students should be taught how to effectively strategize to engage in meaningful mathematics learning.

References

Abedi, A. (2011). *Learning how to learn (Cognitive & Meta-Cognitive Learning skills)*. Isfahan: Bartarin Andisheh.

Achor, E. E. Imoko, B. I. & Jimin, N. (2012). Improving some Nigerian secondary students' achievement in geometry. *New York Science Journal*, 5(1), 37-43.

Altun, S. & Erden, M. (2013). Self-regulation based learning strategies and self-efficacy perceptions as predictors of male and female students' mathematics achievement. *Procedia-social Behavioral Science,* 106, 2354-2364.

Arani, H. K. & Mobarakeh S. D. (2012) Meta-cognitive strategies & logical/Mathematics intelligence in EFL context investigating possible relationships. *Theory and Practice in Language Studies*, 2(2), 304-313.

Ashiaka, D. A. (2010). Students and teachers perception of the causes of poor academic performance in Ogun State secondary schools: Implication for counselling for national development. *European Journal of Social Science,* 13, 229-242.

Bodrova, E. Germeroth, C. & Leong, D. J. (2013). Self regulation. Retrieved online www.toolsofthemindorg. Accessed on 02-03-2014.

Chappins, S. & Stiggins, R. J. (2002). Classroom assessment for learning. *Educational Leadership*, 60(1), 40-43.

Chen, S. C. (2002). Self- regulated learning strategies and achievement in an introduction to information systems course. *Information Technology, Learning and Performance Journal*, 20(1), 11-25.

Chen Y. Ferron, J. M. Gorin J. S. & Thompson, M. S. (2005). Running head. Subgroup comparison of mathematics performance: from a perspective of cognitive attributes.

Cleary, T. J. & Zimmerman, B. J. (2004). Self-regulation empowerment program: A school-based program to enhance self-regulated and sex-motivated cycles of students learning. Wiley Periodicals Inc. *Psychology in the Schools*, 41(5), 537-550.

Dartmouth (2012). Learning strategies inventories: Assess how you learn. Retrieved 8-1-2014 from www.dartmonth.edu/inacskills/success.

Fajemidagba, M. O. Salman, M. & Ayinla, O. (2012). Effect of teachers' instructional strategy pattern on senior secondary school students' performance in mathematics word problems in Ondo. Nigeria. *Journal of Education and Practice,* 3(7), 159 – 169.

Freeman, J. R. (2004). Learning strategies; LD: The educators guide to learning disability and ADHD. Retrieved from on the 17/6/2019.

Hasanbegovic, J. (2016). Learning strategies. Retrieved from edutechwiki.un.ge.ch>learning strategy on the 17/6/2019.

Iri, Y. (2013). A comparative comparison of meta-cognitive knowledge in male and female high school students of Golestan Province – Iran. Retrieved online from on 10-5-14.

Instructionaldesign.org (2018). Learning strategies. Retrieved from https://www.instructionaldesign.org on the 17/6/2019.

Lexico (2019). Definition of learning in English. Retrieved from www.lexico.com on the 17/6/2019.

Liu, E. Z. F. & Lin, C. H. (2010). The survey study of mathematics motivated strategies for learning questionnaire (MMSLQ) for Grade 10-12 Taiwanese students. *The Turkish Online Journal of Education Technology*, 9(2), 221-233

Maduabum, M. A. & Odili, G. A. (2006). Analysis of students performance in mathematics from 1991-2002. *Journal of Research in Curriculum and Teaching,* 1(1), 64-68.

Maliki, A. E. Ngban, A. N. & Ibu, J. E. (2009). Analysis of students' performance in Junior Secondary School Mathematics examination in Bayelsa State of Nigeria. *Stud Home Comm Sci*, 3(2), 131-134.

Mcmillan, J. H. & Hearn, J. (2008). Students self assessment: the key to stronger students motivation and higher achievement. Retrieved from www.files.eric.ed.gov/fulltext accessed on the 21-9-2015.

Metalhdou, P. & Viachou, A. (2007). Motivation belief, cognitive engagement and achievement in language and mathematics elementary school children *International Journal of Psychology,* 42(1), 2-15.

Ministry of Education, (2002). *The Ontario curriculum unit planner.* Toronto, Queen's Printer for Ontario.

Osarumwense, J. H. (2015). Construction, validation and standardization of Mathematics learning strategies scale for secondary school students. Unpublished doctorate dissertation submitted to the office of post graduate studies of the University of Benin, Benin City.

Peklaj, C. & Pecjak, S. (2002). Differences in students' self-regulated learning according to their achievement and and sex. *Studia Psychology*, 44, 29-43.

Pintrich, P. R. & DeGroot, E. V. (1990). Motivational and self-regulated learning component of classroom academic performance. *Journal of Educational Psychology,* 82(1), 33-40.

PISA (2003). Students learning attitudes, engagement and strategies. Retrieved on the 15-5-2014 from http://educate2.ch/pec.

Rolheiser, C, Bower, B, & Stevahn, L. (2000). The portfolio organizer: succeeding with portfolio in your classroom. Alexandra, V A. America Society for curriculum.

Rotgans, I. J. (2009). Motivation, achievement related behaviours and educational outcomes. An unpublished Ph.D. dissertation. Erasmus University, Rotterdam.

Salman, M. F. Mohammed, A. S. Ogunlade, A. A. & Ayinla, J. O. I. (2012). Causes of mass failure in senior school certificate mathematics examinations as viewed by secondary school teachers and students in Ondo, Nigeria. *Journal of Education and Practice*, 3(7), 159-169.

Sharma, A. (nd). Learning ; meaning, nature, types and theories of learning. Retrieved from on the 15/6/2019.

Tien, J. G. (2013). The impact of cognitive monitoring learning logs on college students' developmental mathematics course success problem-solving performance attitude. Retrieved on the 28-1-2014 from udiniproquest.com>education >mathedu.

Yang, C. T. & Lee, S. (2000). The effect of instruction in cognitive and meta-cognitive strategies on Ninth-grade students' metacognitive abilities. Retrieved on the 28-1-2014 from www.caerd.org/../48

Zalmon, I. G. & Wonu, N. (2017). Comparative analysis of students mathematics achievement in West African Examination Senior Secondary Certificate Examination in Nigeria. *European Journal of Research and Reflection in Educational Sciences*, 5(1), 24-31.

Zhu, Z. (2007). Gender differences in mathematics problem solving patterns: A review of literature. Retrieved on the 10-5-2014 from files www.eric.ed.gov.

Zimmerman, B. J. & Campillo, M. (2003). Motivating self-regulated problem solvers. In J. E. Davidson & R. J. Sternberg (eds). *The psychology of problem solving* (233-262), UK: Cambridge University Press.