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Metacognitive Monitoring as Predictor of Mathematics Achievement among Students in Public Secondary Schools in Kenya

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Abstract This study investigated metacognitive monitoring as a predictor of mathematics achievement among students in public secondary schools in Kisii Central Sub County, Kenya. The study was guided by the Social Development Theory (1978) by Lev Vygotsky and the Theory of Education Productivity by Walberg (1981). The study employed the Solomon Four pretest-posttest two group design with posttest only control design. The study population included 1665 form 3 students and 41 form 3 mathematics teachers from public secondary schools in Kisii Central Sub County, Kenya. Purposive, stratified and simple random sampling technique was used to select the participants. The sample size comprised of 360 form 3 students and 11 form 3 mathematics teachers. The findings revealed a statistically significant positive correlation between metacognitive monitoring and mathematics achievement. The study further established that students who monitored their performance did better in mathematics than their counterparts who did not monitor their performance. The study recommended guidance counsellors be trained to identify students with weak metacognitive monitoring skills so that they could be assisted to perform better in mathematics. Future studies could investigate the external environment as a predictor of mathematics achievement among students in secondary schools.

Keywords Metacognitive monitoring, Mathematics achievement, Students, Public secondary schools, Kenya

1. Introduction

A changing and economically competitive world has necessitated reform in mathematics education which has been given a lot of prominence in school systems in many nations as it is regarded as a "thinking" subject by which students are able to observe, reflect and reason logically about learning challenges (Iji, 2008). However, performance outcomes indicate that many students encounter learning difficulties in their academic lives prompting educational psychologists and guidance counselors to turn their attention in trying to understand key processes through which learners may Self-Regulate (SR) their academic tasks and experience improved performance outcomes (Furner and Gonzalez-DeHass, 2011). Global studies have shown that academic achievement can be influenced positively by self-regulating certain personal factors of learners such as metacognitive monitoring and goal-setting among others (Delucchi, 2007; Zimmerman, 2008). Self-regulation enables learners to independently plan and manage their thoughts, emotions and behaviours within a learning environment to successfully direct their learning outcomes (Zimmerman, 2008; Jarvela and Jarvenoja, 2011; Zumbrum, Tadlock and Roberts, 2012).

Studies which have addressed the influence of metacognitive monitoring in the developed west have shown that metacognitive monitoring is a positive predictor of mathematics achievement. For example, Valdez (2013) conducted a study among American undergraduate students and concluded that metacognitive monitoring predicted academic achievement. Xu (2009) reported a positive correlation between high achievers and metacognitive monitoring among Chinese urban secondary school students. Similarly, Java (2014) demonstrated that there was a statistically significant relationship between metacognitive skills strategy and classroom mathematics performance among students in USA. In Guyana, Murray (2013) established that self-regulated learning techniques predicted statistically positive and significant achievement in mathematics among secondary school students.

In an education programme in which the New Zealand

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government included inclusion a self-regulation component in the school curriculum, it emerged that there was improved performance in mathematics among secondary school students (Ministry of Education, 2007). Alotaibi, Tohmaz and Jabak (2017) also established a statistically significant relationship between self-regulation and achievement in mathematics among students in Saudi Arabia. Other studies that support the positive influence of metacognitive monitoring include Clift (2015) who found that self-assessment correlated positively with mathematics achievement, Van der Stel, Veenman, Deelen and Haenen (2009) who established that metacognitive monitoring correlated significantly with mathematics achievement in the Netherlands, and Kristiani, Susilo, Rohman and Aloysias (2015) who established that metacognitive skills correlated positively with mathematics achievement among students in secondary school in Indonesia.

In South Africa, when primary school pupils were placed in an active self-directing role in solving mathematics problems, a marked improvement in the performance in mathematics was observed (Biccard and Weissels, 2011). In Cameroon, Ngeche (2017) established that there was a positive correlation between cognitive attitudes and mathematics achievement among students in secondary schools.

In Kenya, Mutua (2014) investigated students' academic motivation and self-regulated learning as predictors of academic achievement. The results revealed that intrinsic motivation towards accomplishment and organizing strategy had the highest positive predictive value on academic achievement among secondary school students. Students' self-regulated learning was found to have the highest positive predictive value on academic achievement as compared to academic motivation.

The reviewed literature covered investigations on the relationship between metacognitive monitoring and mathematics achievement from the Western world, Asia, Europe, Africa, as well as local Kenyan research findings. The literature also examined the relationship between metacognitive monitoring and mathematics achievement among students in public secondary school students in Kisii Central Sub County, Kenya, but found no studies on the variable under study. The reviewed literature strongly supported the proposition that there was a statistically significant correlation between metacognitive monitoring and mathematics achievement, and that learners who monitored their work in mathematics attained better academic outcomes (Gibbs and Poskitt, 2010).

Notably, education researchers have extensively investigated curriculum and instruction variables and their influence on academic performance, while psychological studies have concentrated on the relationship between student variables such as socio-cultural background, gender, attitudes, self-efficacy and motivation level leaving a gap of investigation in the area of self-regulation techniques (Filmer, 2005; Lee, Zuze and Ross, 2005; Harri and Petteri, 2012; Filmer, Mutua, 2014). Moreover, Bakare (2015) points out that comparatively fewer studies have been undertaken to investigate what Self-Regulated Learning techniques can do to improve performance outcomes, yet this ability and willingness to implement, monitor, and evaluate various metacognitive learning techniques has increasingly been found to improve mathematics achievement among students across all learning levels (Wang, Wang and Li, 2007; Zimmerman, 2008.

In Kenya, performance among students at the KCSE mathematics examinations has been poor for many years (Barmao, Changeiywo, and Githua, 2015). In Baringo County, Kenya the average mean score over a period of 10 years (1999-2008) was 16.013 (Mbugua, Komen, Muthaa and Nkonke, 2012). In Kisii County, results analysis for KCSE mathematics analysis obtained from the Kisii County Director of Education for the years 2014 to 2018 showed that students in public secondary schools performed poorly. Table 1 shows the average mean standard scores over a period of five years between 2014 and 2018.

Table 1. KCSE MSS for two Sub Counties in Kisii County between 2014 and 2018

Year	2014	2015	2016	2017	2018	Average
Kisii Central	2.7472	2.8379	2.4627	2.6471	2.5075	**2.6405**
Kitutu Central	2.8495	3.1230	2.6037	2.8080	2.8403	**2.8449**

Source: *Kisii County Education Office, 2018*

Table 1 shows a declining trend in mathematics performance in Kisii Central Sub County from a mean standard score of 2.7472 in 2014 to a mean standard score of 2.5075 in 2018. In Kitutu Central Sub County, there was a decline in the mean standard score from 2.8495 in 2014 to 2.8403 in 2018. The average mean score in the same period for Kisii Central Sub County was 2.6405 and that of Kitutu Central Sub County was 2.8449.

This declining trend in mathematics achievement has raised a lot of concern among parents, education providers and other education stake holders in light of the heavy investment placed in the education sector. Moreover, the mean scores continued to drop despite efforts from the National and County governments to improve mathematics performance through various programmes such as Strengthening Mathematics and Science in Secondary School Education (SMASSE), in-service programmes, retraining, joint mocks and bench-marking sessions among others (Amadalo, Shikuku and Wasike, 2012). Given that students in public secondary school in Kisii Central Sub-County have continued to perform poorly in mathematics, the present study attempted to illustrate that what has improved mathematics performance elsewhere could work in public secondary schools in Kisii Central

Sub-County. Consequently, this study investigated goal-setting as predictor of mathematics achievement among students in public secondary schools in Kisii Central Sub County, Kenya.

2. Research Methodology

The present study employed the Solomon Four research design which is a standard pretest-posttest two group design with a posttest only control design, involving a comparison of four groups instead of two groups used in a quasi-experimental approach. The design was preferred because it allowed the researcher to use self-reporting questionnaires and interviews to capture participants' views, knowledge, opinions and experiences concerning the study variables (Creswell, 2014; Bryman, 2012). Thus, the researcher was able to apply both quantitative and qualitative approaches of data collection and analysis to examine the relationship between goal-setting and performance in mathematics.

The Solomon four design involved selectively administering an intervention programme to four groups (A, B, C, and D) randomly selected into the groups to investigate the effect of goal-setting intervention programme on performance in mathematics. The first two groups (A and B) were designed and interpreted in exactly the same way as in the pretest-posttest quasi-experiment design and, therefore, provide the same checks upon randomization. The second two groups (C and D) did not have a pretest, only a posttest. Further, Group 'B' and 'D' were control groups and therefore, they did not get the intervention, which was only administered to group 'A' and 'C'. A series of comparison of the pretest and posttest results between and within the groups enabled the researcher to tell whether the pretests influenced the results. Significantly different results showed that pretesting influenced the overall results. Therefore, the pretest would require refinement.

Solomon four design was appropriate to use in the present study because it was possible to control for extraneous factors in several ways. First, the respondents were assigned randomly into their groups through the admission process. Second, the respondents and researcher were masked so as to avoid biases cropping into the research. Third, the design utilized respondents who had similar characteristics. Fourth, its two extra control groups reduce the influence of confounding variables and enables the researcher to test whether the pretest itself had an effect on the subjects. Fifth, the researcher was able to examine between-group differences.

The study targeted 30 public secondary schools, 1665 form 3 students and 41 form 3 mathematics teachers and obtained a sample size of 4 schools, 360 students, and 11 form 3 mathematics teachers using purposive, stratified, and simple random sampling techniques (WHO, 2009; Creswell, 2014). Metacognitive monitoring questionnaire for students was used to collect quantitative data while qualitative data from students was collected using focus group discussions. The study also employed a one-on-one interview schedules to obtain qualitative data from form 3 mathematics teachers. To ensure validity of research instruments in the present study, face, construct and content validities of questionnaires, and interview schedules was determined through discussion with two experts from the School of Education in Jaramogi Oginga Odinga University of Science and Technology (JOOUST) who gave their views on the relevance, clarity and the applicability of the questionnaire and interview schedule. Their suggestions were in cooperated in the final instruments which were used to gather both quantitative and qualitative data. Reliability of the metacognitive monitoring questionnaire was computed using Cronbach's alpha and found that all the items had good internal consistency, $\alpha = .751$; all the items of this subscale were worthy of retention. Oso and Onen (2013) posit that instruments with an internal consistency of alpha greater than .70 is adequate for data collection in a study. Descriptive and inferential statistics were used to analyze quantitative data while qualitative data were analyzed thematically. Mathematics achievement was measured using a maths test which was administered and marked.

3. Findings and Discussion

To establish whether there was any statistical relationship between metacognitive monitoring and mathematics achievement the null hypothesis was tested. The hypothesis stated:

> *H_0: There is no statistically significant relationship between metacognitive monitoring techniques and mathematics achievement among students in public secondary schools in Kisii Central Sub County, Kenya.*

A Pearson Moment Correlation Coefficient was conducted to investigate the influence of metacognitive monitoring on mathematics achievement among students in public secondary schools by testing the hypothesis that: "*there is no statistically significant relationship between metacognitive monitoring and mathematics achievement among students in public secondary schools*". The results are shown in Table 2.

Table 2 presents the correlation analysis results of SPSS output.

Table 2 shows a that there was a significant positive relationship between metacognitive monitoring and mathematics achievement. Since the calculated *p*-value was less than the prior set significant level of .05, the null hypothesis was rejected. However, although the influence was low (r 0.313), it was concluded that the more the application of metacognitive awareness technique, the higher the achievement in mathematics among secondary school students. This finding was supported by a number of studies (Java, 2014; Clift, 2015; Safari and Meskini, 2015) who all concluded that metacognitive monitoring positively correlated with mathematics achievement.

Table 2. Correlation between Metacognitive Monitoring and Mathematics Achievement

		Mathematics achievement	Metacognitive Awareness
Mathematics achievement	Pearson Correlation	1	.313**
	Sig. (2-tailed)		.000
	N	313	313
Metacognitive Awareness	Pearson Correlation	.313**	1
	Sig. (2-tailed)	.000	
	N	313	313

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3. Model Summary: *Influence of Metacognitive monitoring on Mathematics Achievement*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.313[a]	.098	.095	.15050	.098	33.706	.000
2	.777[b]	.604	.600	.10000	.506	197.705	.000

a. Predictors: (Constant), Metacognitive Awareness
b. Predictors: (Constant), Metacognitive Awareness, Pretest Status, Treatment Status

Table 4. Coefficients of Linear Regression: *Metacognitive Monitoring, Treatment Status and Pretest Status on Mathematics Achievement*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.248	.038		58.955	.000
	Metacognitive Awareness	.319	.055	.313	5.806	.000
2	(Constant)	2.265	.027		85.132	.000
	Metacognitive Awareness	.119	.038	.116	3.120	.002
	Treatment Status	.233	.012	.738	19.853	.000
	Pretest Status	.002	.011	.006	.161	.872

a. Dependent Variable: Mathematics achievement

However, given that there was treatment on some group of students, there was need to control for the possible effect of treatment and pretesting effect to find out whether metacognitive monitoring alone was still able to predict a significant amount of the variance in mathematics achievement among students in public secondary schools. This was done using hierarchical multiple regression as shown in the Model Summary box in Table 3.

From Table 3, Model 1 is the first block of variable (Metacognitive monitoring) that was entered alone, while Model 2 includes the other two variables (treatment status and pretesting status). Block 1 (Metacognitive monitoring alone) explains 9.5 per cent of the variance in mathematics achievement. However, after adding the variable "treatment status" and "pretesting status" in Block 2, the model accounted for 60.4 per cent of the variance in mathematics achievement. The R square change value in Model 2 was .506, implying that treatment and pretesting status explained an additional 50.6% of the variance in mathematics achievement among students in secondary schools. Therefore, this change made a statistically significant contribution, as indicated by the Sig. F change value. To find the actual influence of each variable linear regression was generated as shown in Table 4.

From the coefficient Table 4, Model 2 shows when students improved in their metacognitive monitoring by one unit then their level of achievement in mathematics would improve by .119 units. Further, that students who received metacognitive monitoring as an aspect of self-regulated learning did better by .233 units than their counterparts who did not receive the treatment. However, pretesting status did not make significant contribution on influencing mathematics achievement. The results show that if a student were inducted on metacognitive monitoring as an aspect of self-regulated learning strategy his/her mathematics achievement would improve by .738 standard deviations and pretesting would make mathematics achievement change by only 0.006 standard deviations, which was not significant. Similar findings have been obtained from global, regional and local studies (Clift, 2015; Musso, Kyndt, Cascallar and Dochy, 2012; Al-Mutawah and Fateel, 2018; Ngeche, 2017; Oyuga, Aloka and Raburu, 2016; Njagi, 2015 among others) who have reported significant positive relationship between metacognitive monitoring and achievement in mathematics.

The findings of the study established that, to a fairly large extent, the students in public secondary schools in Kisii Central Sub County exhibited thought processes towards learning mathematics; most of the students tended to plan before solving mathematics problems and made appropriate adjustments towards completion of tasks or meeting their goals. This implies that some students generally incorporate self-regulated learning strategy as an aspect of metacognitive learning strategies in mathematics. The results of the survey showed that most acted in a goal oriented manner experimental group (95.2%) and control group (88.9%). Xu, (2009) carried out a study which concurred that high achieving students often worked to budget their time and handle distractions appropriately. However, while the mathematics teachers agreed planning is an important element of learning, they did not give students to plan how to tackle problems in class. The opinion from the following excerpt sums it:

> *"Most students in my class are not aware of different metacognitive strategies they can use to solve mathematics problems. I don't teach them about metacognition. I just work some two or three examples for them on the chalkboard and then give them some numbers from that chapter to solve in class so that they can do some practice. If class time is not enough I give the students work which they can do at home for more practice when we don't have enough time in class. I think that if the students solve many numbers they can know the method of solving them because the more they practice the more they can know mathematics well"* (Teacher, 9).

After the intervention programme students in a focus group discussion confessed that they didn't spend time at the beginning of the lesson to plan how to solve the mathematics problems. Two participants observed:

> *"For sure we don't do any planning at the beginning of the lesson. Teacher simply comes in and greet us and then start teaching. We are given many sums after the teacher's example to solve in class or after class during our free time for practice"* (P_5, FGD_3).

> *"For me this is a new experience which I have found to be very helpful. If we continue to do like this then I can become good in mathematics I think"* (P_4, FGD_3).

From the excerpts it was evident that the students found the intervention programme useful to them and they expressed the desire that the approach be continued in their classes even in other subjects. The finding was in keeping with findings in New Zealand which demonstrated that when students were taught through self-regulation they performed better academically (Ministry of Education, 2007). The intervention programme was a self-regulating process which enabled the students to independently plan and manage their thoughts, emotions, and behaviours in mathematics so that they experienced successful learning outcomes (Zimmerman; 2008; Zumbrum, Tadlock and Roberts, 2012).

From the analysis of the students' responses, the results of the survey show that some of the students were able to control their own cognitive processes in relation to set goals in learning by using different strategies and effectively solving problems they come across when learning mathematics. In support of the foregoing finding, Clift (2015) established a significant correlation between self-assessment, goal setting and mathematics performance.

The study showed that although there was varied level of planning among the students before solving mathematics problems, majority of them alluded that they usually set direction first on what to do, organize their activities and thoughts in a logical way, as they performed tasks at hand. For example, most of the student respondents (experimental =73.8%; control=72.2%) confirmed that they always thought about what they really needed to learn before beginning the task and they asked themselves if there was an easier way to do things before they finished a task. Likewise, slightly more than a half (56.0%) of the students revealed that they always paced themselves appropriately while learning in order to have enough time. In regard to this finding Jarvela and Jarvenoja established that self-regulation enables learners to develop better practices for their study skills and at the same time they are able to monitor their academic achievement as they evaluate their outcomes. However, this finding was not supported by qualitative findings from focus group discussion. The participants asserted:

> *"We are not given time at the beginning of the lesson to lay down plans of how to proceed with the lesson. The teacher simply comes in the class and greets the class after which he introduce the topic and work out some two or three examples for us, then give us problems to solve using his example. But with the new programme we are doing better in mathematics"* (P_6, FGD_1).

Evidence from the focus group discussion shows that students did not engage in prior planning for the lesson at hand. Thus, the qualitative findings suggest that the findings from the questionnaires were more of an academic exercise than what actually took place during the mathematics lessons. This might be explained by the findings of Zumbrum, Tadlock and Roberts (2012) who noted that while self-regulated learning is an important predictor of academic motivation and achievement by enabling students to independently plan, monitor, and access learning, few students naturally self-regulate. On the contrary, literature from different researchers (Musso, Kyndt, Cascallar and Dochy, 2012; Rahman *et al.,* 2010; Ngeche, 2017) concurred that metacognition (planning, monitoring and evaluation) were significant predictors of mathematics achievement. Therefore, in this aspect the questionnaires did not provide accurate assessment.

As regards monitoring, the results of the survey revealed that as an aspect of metacognitive learning process, there was indication that many of the students had put in place strategies to monitor and evaluate their learning process. For instance, many (experimental =70.2%: control=70.8%) of the students indicated they always asked themselves questions about how well they were doing while they were learning something new. This aspect of evaluation is part of metacognitive technique of learning (Morales, 2015; Saricam and Ogurlu, 2015) who among other researchers agree on the importance of metacognition on achievement in mathematics. The students periodically reviewed to help them understand important relationships and they often asked themselves if they learned as much as they could have once they finished a task. This aspect of self-assessment was found to be a significant predictor of mathematics achievement by Clift (2015). Similarly, as a way of strategizing, some (47.6%) students said they drew pictures or diagrams to help them understand what they were learning and many (experimental = 67.9; control=63.9%) of them said they often asked themselves how well they had accomplished their goals once they had finished.

4. Conclusions and Recommendations

The overall objective of the study was to investigate the influence of intervention through trainings on metacognitive monitoring technique as predictor of mathematics achievement among students in public secondary schools in Kisii Central Sub County. Using the Solomon Four experimental design approach, a paired sample t-test was used to determine the difference in mathematics achievement between the experimental and control groups. The results showed that groups that received treatment reported statistically significant positive mathematics achievement than their counter parts who did not receive treatment. Hence, the study concluded that the use of metacognitive monitoring learning technique was effective in improving performance in mathematics among students in public secondary schools.

Following findings that metacognitive monitoring is a significant predictor of mathematics performance among students in public secondary schools, the study recommends that the Kenya Institute of Curriculum Development infuse a component of metacognitive monitoring in the secondary school curriculum. The study further recommended that teacher counselors be trained to identify students with weak goal-setting skills so that they could be assisted to perform better in mathematics.

This study contributed significantly to the body of literature on goal-setting as a predictor of mathematics performance. However, since there were few local studies observed during literature review, the study recommends that future investigations could focus on group dynamics as a predictor of academic achievement.

REFERENCES

[1] Alotaibi, K., Tohmaz, R. & Jabak, O. (2017). The Relationship Between Self-Regulated Learning and Academic Achievement for a Sample of Community College Students at King Saud University. *Education Journal,* 6(1): 28-37.

[2] Al-Mutawah, M. A. & Fateel, M. J. (2018). Students' Achievement in Math and Science: How Grit and Attitudes Influence? *International Education Studies,* 11(2): 97-105.

[3] Aloysius, A. C. & Onyedike, C. C. (2012). The Effects of Self-Instructional Learning Strategy on Secondary Schools Students' Academic Achievement in Solving Mathematical Word Problems in Nigeria. *African Research Review:* 6(4), 302-323.

[4] Amadalo, M. M., Wasike, D. W. & Wambua, J. M. (2011). Effectiveness of Teaching Preparations on Mathematics Achievement: The Case of Kenya. *Problems of Education in the 21st Century,* 31, 7-17.

[5] Anderson, E. M. & Wolters, C. A. (2006). Goals, values, and affect: Influences on student motivation. In P.A. Alexander and P.H. Winne (Eds.). *Handbook of Educational Psychology* (Second edition ed., pp. 369 – 389). Mahwah: Lawrence Erlbaum.

[6] Bakare, B. M. (2015). *Students' Adversity Quotient and Related Factors as Predictors of Academic Achievement in the West African Senior School Certificate of Examination in South Western Nigeria.* (PhD. Thesis). University of Ibadan, Nigeria.

[7] Biccard. P. & Weissels, D. (2011). Development of affective modelling competencies in primary school learners. *Pythagoras,* 32(1), 9 pages.

[8] Clift, L. D. (2015). *The Effects of Student Self-Assessment with Goal-Setting on Fourth Grade Mathematics Students: Creating Self-Regulating Agents of Learning.* (PhD Thesis): Liberty University.

[9] Creswell, J. W. (2014). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (4th ed.). Essex: Pearson Education.

[10] Filmer, D. (2005). Gender & Wealth Disparities in Schooling: Evidence from 44 Countries. *International Journal of Educational Research:* 43(6), 351-369.

[11] Gibbs, R. & Poskitt, J. (2010). *Student Engagement in the Middle Years of Schooling (Years 7-10): A Literature Review.* Retrieved from: http://www.educationcounts.govt.nz/__data/assets/pdf_file/0010/74935/940_Student-Engagement-19052010.pdf.

[12] Harri, P. & Petteri, V. (2012). Learning Attaiments as a Result of Student Activity, Cognition and the Classroom Environment. *Problems of Education in the 21st Century,* 41, 75-86.

[13] Iji, C. O. (2008). *Reforming School Mathematics Curriculum in Line with Global Challenges.* Proceedings of the 49th Annual Conference of STAN, pp. 226-230.

[14] Java, L. A. (2014). *Problem Solving Strategies and Metacognitive Skills for Gifted Students in Middle School.* (Masters Thesis). Louisiana State University.

[15] Kristiani, N., Susilo, H., Roliman, F. & Aloysius, D. C. (2015). The contribution of students' metacognitive skills and Scientific attitude towards their academic achievement in biology learning implementing Thinking Empowerment by Questioning (TEQ) learning integrated with inquiry learning (TEQI). *International Journal of Educational Policy Research and Review,* 2(9): 113-120.

[16] Lee, V. E, Zuze, T. L. & Ross, K. N. (2005). School Effectiveness in 14 Sub-Saharan African Countries: Links with 6th Graders' Reading Achievement. *Studies in Educational Evaluation:* 31(2-3), 207-246.

[17] Mbugua, Z. K., Komen, K., Muthaa, G. M. & Nkonke, G. R. (2012). Factors Contributing to Students' Poor Performance in Mathematics at Kenya Certificate of Secondary Education in Kenya: A Case of Baringo County, Kenya. *American International Journal of Contemporary Research,* 2(6), 87-91.

[18] Ministry of Education, (2007). *The New Zealand Curriculum.* Learning Media Ltd. Wellington, New Zealand.

[19] Morales (2015). Relationship between Cognitive Processes and Academic Performance in High School Students. *Psychologia: Avances de la Disciplina,* 9(2): 85-100.

[20] Murayama, K., Pekrun, R., Lichtenfeld, S. & Hofe, R. (2012). Predicting Long-Term Growth in Students' Mathematics Achievement: The Unique Contributions of Motivation and Cognitive Strategies. *Child Development,* 00(0): 1-16.

[21] Murray, J. (2013). The Factors that Influence Mathematics Achievement at Berbice Campus. *International Journal of Business and Social Science,* 4(10): 150-164.

[22] Musso, M., Kyndt, E., Cascallar, E. & Dochy, F. (2012). Predicting Mathematical Performance: The Effects of Cognitive Processes and Self-Regulation Factors. *Educational Research International,* 2012(250719): 1-13.

[23] Mutua, M. S. (2014). *Academic Motivation and Self-Regulated Learning as Predictors of Academic Achievement of Students in Public Secondary Schools in Nairobi County, Kenya.* (PhD Thesis). Kenyatta University: Nairobi.

[24] Ngeche, T. N. M. (2017). Student and Teacher Attitudes as Correlates of Performance in Mathematics in Cameroon Secondary Schools. *International Journal of Humanities Social Sciences and Education,* 4(12): 1-10.

[25] Olugunju, A. M. (2015). The Effects of Formative Assessment on Students' Achievement in Secondary School Mathematics. *International Journal of Education and Research,* 3(10): 481-490.

[26] Rahman, F., Jumani, N. B., Chaudry, M. A., Chisti, S. H. & Abbasi, F. (2010). The Impact of Metacognitive Awareness on Performance of Students in Chemistry. *Contemporary Issues in Education Research,* 3(10): 39-44.

[27] Safari, Y. & Meskini, H. (2015). The Effect of Metacognitive Instruction on Problem Solving Skills in Iranian Students of Health Sciences. *Global Journal of Health Science,* 8(1), 150-156.

[28] Uchechi, I. E. (2013). Enhancing Mathematics Achievement of Secondary School Students Using Mastery Learning Approach. *Journal of Emerging Trends in Educational Research and Policy Studies,* 4(6): 848-854.

[29] Valdez, E. A. (2018). Predictors of Mathematics Performance of the Grade VI Pupils of Cauayan Northeastern District: Basis for Intervention Program. *The Online Journal of New Horizons in education,* 6(4), 151-154.

[30] Valdez, A. (2013). Student Metacognitive Monitoring: Predicting Test Achievement from Judgment Accuracy. *International Journal of Higher Education,* 2(2): 141-146.

[31] Van der Stel, M., Veenman, M.V.J., Deelen, K. & Haenen, J. (2009). The increasing role of metacognitive skills in math: a cross-sectional study from a developmental perspective. *ZMD Mathematics Education,* 42(2010): 219-229.

[32] Walberg, H. J. (1981). A psychological theory of educational productivity. In F.H. Farley and N.J. Gordon (Eds.), *psychology and education.* Chicago: National Society for the Study of Education.

[33] Wang, C., Wang, L. & Li, Y. (2007). *Chinese Secondary School Self-regulated Learners of English.* Paper presented at TESOL (Teacher of English to Speakers of Other Languages), 2007 Convention, Seattle, WA.

[34] WHO, (2009). *Sample size and sampling methods.* Paper presented at the training course in Reproductive Health Research.

[35] Xu, J. (2009). School Location, Student Achievement, and Homework Management Reported by Middle School Students. *The School Community Journal:* 19(2), 27-44.

[36] Zimmerman, B. J. (2008). Investigating Self-regulation and Motivation: Historical Background, Methodological Development, and Future Prospects. *American Educational Research Journal,* 45, 166-183.

[37] Zumbrum, S., Tadlock, J. & Roberts, E. D. 2012). *Encouraging Self-Regulated Learning in the Classroom: A Review of Literature.* Metropolitan Educational Research Consortium: Virginia Commonwealth University.