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Relationship between Goal-Setting and Mathematics Achievement among Students in Public Secondary Schools in Kenya

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Abstract The purpose of this study was to investigate selected goal-setting as a predictor of mathematics performance among students in public secondary schools in Kisii Central Sub-County, Kenya. The study was guided by the Social Development Theory (1978) by Levi 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. Questionnaires were used to collect quantitative data while qualitative data were collected using interview schedules. The normality of goal-setting was established using the Shapiro-Wilk test and was established at Lilliefors significance Correlation of value .961. Trustworthiness of qualitative data was ensured using Shenton (2004) criteria for trustworthiness. The study used descriptive and inferential statistics to analyze quantitative data while qualitative data were analyzed with the help of the thematic framework. The findings revealed a statistically significant positive correlation between goal-setting and mathematics achievement. The study further established that students who set goals performed better in mathematics than their counterparts who did not set goals. The study recommended that universities, which train secondary school teachers, should include aspects of goal-setting as a self-regulated learning technique in their training programmes.

Keywords Goal-setting, Mathematics performance, Students, Public, Secondary schools, Kenya

1. Introduction

Education has been used as a tool for preparing children to acquire work skills that can place themselves in competitive job positions in their countries as well as in the increasingly competitive global markets (Uchechi, 2013; Olugunju, 2015). This performance based environment places children under pressure from their parents and teachers to outperform each other in national examinations (Anderman and Wolters, 2006; Mutua, 2014). 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 across the globe as it is regarded as a "thinking" subject by which students are able to make observations, 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 goal setting and attribution 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).

Numerous studies in the developed west have shown that goal-setting is a positive predictor of mathematics achievement. For example, Mok, Wong, Su, Tognolini, and

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Stanley (2014) conducted a study to identify how personal best goals and self-regulation predicted mathematics achievement among primary 3 to 5 students in Hong Kong. The results of the study indicated that students' personal best goals predicted mathematics performance at all levels. Rowe, Mazzotti, Ingram and Lee (2017) investigated the effects of goal-setting instruction on academic engagement for middle school students at risk of academic failure in the United States and concluded that when goal-setting was employed in mathematics, the learners became actively engaged and attained improved outcomes. In Saud Arabia, Alotaibi, Tohmaz and Jabak (2017) established a statistically significant relationship between self-regulation and achievement in mathematics. Similar findings were arrived at by Martin and Elliot (2016) in a study among elementary and secondary school students in mathematics in Australia, and Smithson (2012) in a study among elementary school children in Georgia, USA arrived at similar results. In New Zealand, the inclusion of a self-regulation component in the school curriculum led to improved performance among secondary school students (Ministry of Education, 2007).

In Malaysia, examination outcomes have shown that students in secondary schools continue to perform poorly in mathematics in spite of the many strategies that have been put in place to improve its performance (Ismail, 2008), and yet Loong (2012) demonstrated that self-regulated learning techniques were used to improve performance in mathematics among international university students in Malaysia. Although Ignacio and Reyes (2017) found that there was no significant difference in the mathematics achievement goals based on learning styles among students in the Philippines, there was an overwhelming observation that the majority of studies concluded that goal-setting was significantly positively correlated with mathematics achievement. For instance, Riyaz (2013) did a study to determine if higher secondary students' beliefs about their mathematical ability, goals, and learning strategies were related to their mathematics achievement. The study findings indicated that mastery goals and deep learning strategies were significantly related to mathematics achievement.

In Nigeria, Iyabo, Chibuzoh and Louisa (2014) carried out a study which established that goal-setting skills improved academic performance in English among students in secondary schools, while Aloysius and Onyadike (2012) established a significant correlation between goal-setting and mathematics achievement among students in secondary schools. Musa, Dauda and Umar (2016) found out that goal-setting significantly improved performance in mathematics boarding secondary school students.

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. Students' self-regulated learning was found to have the highest positive predictive value on academic achievement as compared to academic motivation.

The literature review in the present study covered investigations on the relationship between goal-setting and mathematics achievement from the Western world, Asia, Europe, Africa, as well as local Kenyan research findings. The review which also examined the relationship between goal-setting and mathematics achievement among students in public secondary schools in Kisii Central Sub County, Kenya found few studies on goal-setting variable as a predictor of mathematics achievement. The reviewed literature strongly supported the proposition that goal-setting correlated significantly and positively with mathematics achievement, and that learners who set goals were able to use goal-setting technique to realize better academic outcomes (Gibbs and Poskitt, 2010). None-the-less, the reviewed literature identified some gaps which formed the basis for the present study.

Walberg (1981) posits that self-regulated learning techniques improve mathematics achievement among learners. Studies from developed countries (Bernard, 2013; Froiland and Davison, 2016; Long, 2012; Mutua, 2014) demonstrated that self-regulated learning techniques improve mathematics performance. However, Bakare (2015) observes 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 self-regulation learning techniques has increasingly been found to improve mathematics achievement among students across different levels of learning globally.

Most of the studies which have been carried out have tended to investigate the student variables such as socio-cultural background, gender, attitudes, self-efficacy and motivation level, and their influence on academic achievement among secondary school students (Filmer, 2005; Lee, Zuze and Ross, 2005; Harri and Petteri, 2012; Filmer, Mutua, 2014). Teacher education researchers have extensively researched on curriculum and instruction while the constructs of self-regulated learning techniques have been left for educational psychologists who have observed a close relationship between self-regulation and its predictive properties on academic achievement (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 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 presents the mean scores for two sub counties.

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. These MSS averages were lower than the national mean for 2015 which was at 3.4000.

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*

Although the average mean score for Kitutu Central Sub County (2.8449) was also low, it was none-the-less high than that of Kisii Central Sub County (2.6405). 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).

Williamson (2015) asserted that learning is active construction of knowledge and not a mere absorption of knowledge, and therefore, students ought to be taught how to self-regulate in order to construct their own knowledge on different tasks. Therefore, the need to carry out a local study to examine the influence goal-setting could have in improving mathematics performance 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 designs 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). Goal-setting 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 goal-setting 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.

3. Findings and Discussion

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

H_0: There is no statistically significant relationship between goal-setting techniques and mathematics achievement among students in public secondary schools in Kisii Central Sub County, Kenya.

To establish how goal-setting predicted mathematics achievement among students in public secondary schools, a Pearson Moment Correlation Coefficient was used to investigate the influence. Table 2 presents the correlation analysis results of SPSS output.

Table 2. Correlation between Goal-Setting and Mathematics Achievement

		Mathematics achievement	Goal-setting
Mathematics achievement	Pearson Correlation	1	.482**
	Sig. (2-tailed)		.000
	N	313	313
Goal-setting	Pearson Correlation	.482**	1
	Sig. (2-tailed)	.000	
	N	313	313

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

Table 2 shows that there was a statistically significant positive relationship between goal-setting and mathematics achievement, with improved use of goal-setting learning technique resulting to improved mathematics achievement. Given that the calculated p-value was less than the prior set significant level of .05, the null hypothesis was rejected. However, although the influence was relatively low it was concluded that the more appropriate goal-setting learning technique was applied, the higher the mathematics achievement among students in public secondary schools. This view is supported by a number of studies (Medina, 2011; Mutua, 2014; Rowe, Mazzotti, Ingram and Lee, 2017; Alotaibi, Tohmaz and Jabak, 2017) which established that goal-setting positively predicted 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 status to find out whether goal-setting alone was still able to predict a significant amount of the variance in mathematics achievement among secondary school students. This was done using hierarchical multiple regression as shown in the Model Summary in Table 3.

Model 1 is the first block of variable (Goal-setting) that was entered alone, while Model 2 included the other two variables (treatment status and pretesting status). It is evident that Block 1 (Goal-setting Learning Technique alone) explains 23.2 per cent of the variance in mathematics achievement. However, after adding the variable "treatment status" and "pretesting status" in Block 2, the model now as a whole explained 63.6 per cent of the variance in mathematics achievement. The R square change value in Model 2 is .403, implying that treatment and pretesting status explained an additional about forty per cent (40.3%) of the variance in mathematics achievement among students in public secondary schools. Therefore, this change made a statistically significant contribution, as indicated by the Sig. F change value.

Table 3. Model Summary: Influence of Goal-Setting on Mathematics Achievement

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics	
					R Square Change	Sig. F Change
1	.482[a]	.232	.230	.13884	.232	.000
2	.797[b]	.636	.632	.09595	.403	.000

a. Predictors: (Constant), Goal-setting

b. Predictors: (Constant), Goal-setting , Pretest Status, Treatment Status

Table 4. Coefficients of Linear Regression: Goal-Setting, Treatment Status and Pretest Status on Mathematics Achievement

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.627	.087		18.773	.000
	Goal-setting	.197	.020	.482	9.698	.000
2	(Constant)	1.965	.063		31.360	.000
	Goal-setting	.093	.015	.226	6.101	.000
	Treatment Status	.216	.012	.685	18.494	.000
	Pretest Status	-.005	.011	-.015	-.434	.665

a. Dependent Variable: Mathematics achievement

The results shows that when students improved in their goal-setting by one unit, their level of achievement in mathematics improved by .226 units. It can also be noted that students who were inducted (treated) on goal-setting techniques as an aspect of self-regulated learning did better by .685 units than their counterparts who did not receive the treatment. Riyaz (2013); and Smithson (2012) concur arrived at by the present study which demonstrated that goal-setting was positively and significantly correlated with mathematics achievement among students in public secondary schools. Martin and Elliot (2016); Plante, O'Keefe and Theoret (2012) and Iyabo, Chibuzoh and Louisa (2012) all found that secondary school students who set goals in mathematics and other academic areas excelled in their performance.

In relation to goal-setting as a predictor of performance in mathematics, qualitative findings from teachers agreed about the importance of goal-setting as a technique used by schools for the improvement of performance in mathematics among form 3 students in public secondary schools. However, their

goals were long term focusing KCSE results. Some teachers had this to say about goal-setting:

"The school has a goal-setting policy whereby goals are set based on the previous year's performance. The goal is usually set by adding a 1.5 index to the mean standard score of the previous year. The teachers and students then work towards meeting that goal of improving by 1.5 index target so every year we have a different goal. If we don't reach the goal for that year or if we drop, the existing goal remains" (Teacher, 1).

Still another teacher on the same said:

"We use continuous assessment tests, about two or three per term to see if students can improve and meet the institutional target for the year. Students use the goal set by the school and those who reach or pass it are rewarded. The more CATS the students do, the more likely that they are going to reach the target set by the school" (Teacher, 5).

The comments just highlighted demonstrate that while goal-setting was a common feature in the majority of schools sampled, only long term goals were set and these were targeting the improvement of MSS at the end of the year based on the previous year's MSS. As a way of supporting the long term goal-setting technique, the researcher observed in two of the schools visited placards strategically placed in the school compounds (classroom doors, parade grounds, school gate, dorm doors) displaying the targeted MSS for the year. On inquiring about the placards, one form three mathematics teacher said:

"Once goals have been set by the mathematics department we make placards and pin them at strategic points such as school gate, dormitories, playgrounds, classroom walls, and parade ground so that students continue remembering the targets they have been given to reach for that year. At the end of the term we check to see how close the targets reached are to the school mean target" (Teacher, 11).

The above excerpts derived from mathematics teachers show that goal-setting technique was used widely by the schools as a technique for the improvement of mathematics. A similar observation was arrived at by Onderi, Bantu and Baluku (2016) who found out that students who did not set targets performed poorly in mathematics. When asked about other techniques used to improve performance in mathematics, most of the teachers (72.73%) stated that they used homework, classwork, reinforcement and CATs to help learners to meet the targeted MSS. In response to the question "How do you set goals in mathematics?" in focus group discussion sessions students had this to say:

"The department sets goals for us and we are asked to work towards attaining those goals by the end of the year. If you meet the goal, you are asked to set a higher goal, but if you don't, you continue working on the earlier goal" (P_2, FGD_1).

On the same note another student participant remarked:

"The first thing we did at the beginning of the year was to set our goals based on the goal of the mathematics department. If the teacher was not satisfied with your goal he advised you to set another one which is close to the school goal" (P_5, FGD_2).

From the student excerpts about goal-setting it is clear that students were involved in goal-setting in mathematics. However, it emerged that students didn't set their own goals since whichever goals they set were subject to the approval of their mathematics teachers who usually advised students to set higher goals. It emerged from the results of the survey that most of the students seemed to appreciate the fact that goal setting was fundamental to long-term success, a notion supported by (Iyabo, Chibuzoh and Louisa, 2014), and so they set academic targets in mathematics that they strove to attain. Thus some of the students knew that it was difficult to get to a desired destination before clearly defining the destination. For example, many of the students confirmed that they set goals to achieve what they thought was important, some said they set goals to help them improve and others observed that they set goals to help them be more successful in school, as reflected by a mean of 4.43. Reviewed literature agreed with the observation that students who set goals in mathematics invariably do better than those who do not set goals. For instance, Martin and Elliot (2016) found that elementary and secondary school Australian students who set personal best goals realized improved performance in mathematics.

In the same vein, a student remarked that having goals was important to him because the goals helped him to focus on what he wanted to become in the future. The respondent understood that to join certain professional courses like engineering required a good understanding of mathematics. Rowe, Mazzotti, Ingram and Lee (2017) observe that when goal-setting is employed in learning mathematics, the learners become actively engaged and attain greater outcomes. The student observed:

"Goals will help me to focus on what I want to become….. an engineer when I join the university and if I don't do well in mathematics, it will not be possible to be accepted to do engineering in the future because myself I want to be an engineer in my career" (P_3, FGD_2).

The foregoing excerpt indicates clearly that participant 3 in focus group 2 believed that goals were important because they helped pursue future career. The participant who was aiming to become an engineer understood the need to perform well in mathematics as a way to gain entry into the engineering profession which required that one attain high mathematics performance to be eligible for university entry.

Equally, many of the students alluded that they set short-term goals for themselves in finishing all their homework or exercising within an hour, as reflected by a mean of 3.80 Some of the students confirmed that they set short-term goals (for end of term tests) so as to achieve their long-term goals (end of year tests). The findings showed that

whereas some of the students only set short term goals, other students focused on long term goals. For instance, a respectable proportion of the students hinted that they set long-term goals for themselves such as earning a college degree or entering a career, translating to a mean response of 3.85 and 3.98, for the treatment group and control group, respectively. Never-the-less, some students set short term goals as strategy to achieve their long term goals. This was revealed by the response of the students on the item "when I want to learn something, I make small goals to track my progress" which attracted a mean response rate of 3.21 from the experimental group and from the control group. This finding was similar to the study by Plante, O'Keefe and Theoret (2012) who established that expectance values predicted performance outcomes through achievement goals.

Investigating the influence of weekly goals on performance by students in Georgia, Smithson (2012) demonstrated that setting short term goals predicted assessment scores in mathematics. Concerning short-term goals, the mathematics teachers appeared to think in terms of end of term goals rather than weekly or end of lesson goals. The teachers argued that they only set goals to focus on end of the term and end of the year mean grade scores. Therefore, the teachers saw their end of term goals as short term goals and the end of year goals were their long term goals. One teacher remarked thus about short-term goals:

> *"We set goals which we would like to attain by the end of the year. So to encourage students to meet the end of the year goals we give them continuous assessment tests every month for three months and compute the scores at the end of the term to get their MSS for that term. We compare the MSS for the term with the MSS target for the end of the year to see how near we are to it. So our goal for the end of term is assessed in terms of the goal for the end of the year. If the students attain MSS for the year in first term, for example, then we raise the MSS for the students. But if they don't reach the goal for the year it remains. We don't have weekly goals since we cannot have time to test them weekly and mark their work because it will be too much work for us"* (T, 4).

The foregoing excerpt shows that teachers considered the goals attained at the end of the term as short-term goals. The same excerpt shows that weekly goals were not set supposedly because it would entail a lot of work for teachers in marking and computing weekly tests. The view that there were no weekly goals concurs with the views of the students who said that they set short term goals which they pegged to the end of term results.

4. Conclusions and Recommendations

The overall objective of the study was to investigate the influence of intervention through trainings on goal-setting technique as predictor of mathematics achievement among students in public secondary schools. 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 goal-setting learning technique was effective in improving performance in mathematics among students in public secondary schools. Following findings that goal-setting 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 goal-setting 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.

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