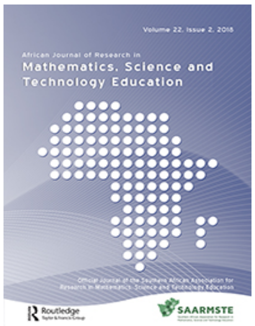

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Cognitive Appraisals, Achievement Emotions, and Motivation towards Learning Mathematics among Lower Secondary Students

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Guided by the control-value theory of achievement emotions, we examined the relationship between cognitive appraisals (i.e. self-efficacy and task value), learning anxiety, test anxiety, enjoyment and motivation towards learning mathematics among 302 students in their first year of lower secondary school in Uganda. Students were randomly selected from four urban schools located in Central and Western Uganda. Data were collected using several subscales from the Attitudes towards Math Inventory, the Abbreviated Math Anxiety Scale, and the Motivated Strategies for Learning Questionnaire, and analysed by structural equation modelling in Mplus 7.4. Results indicated a significant contributions of students' cognitive appraisals towards enjoyment and anxiety for math. Additionally, enjoyment mediated the relationship between students' cognitive appraisals and learning motivation. Several ways are discussed of strengthening students' self-efficacy and task value as early as the first year of lower secondary school for higher enjoyment and motivation for learning maths.

Keywords: *Anxiety; cognitive appraisals; enjoyment; motivation; structural equation modelling*

Introduction

Despite the huge investments in science education among different nations worldwide, the challenge of low achievement in science subjects and especially maths remains a contentious issue, more so in developing countries. In Uganda, for example, over the past five years, maths has ranked among the three worst performing subjects at lower secondary school level. Numerous studies (e.g. Chouinard & Roy, 2008) have tied students' poor achievement in maths to low efficacy and value beliefs, low enjoyment and high maths anxiety which consequently lead to low motivation in learning the subject. It has been reported that students' decrease in maths learning motivation is evident as early as the first years of lower secondary school (Wijsman, Warrens, Saab, Van Driel, & Westenberg, 2015), which is also true for Ugandan students (Kiwanuka et al., 2016). Several studies investigating students' attitudes (e.g. value beliefs and enjoyment) and motivation towards learning maths in Uganda have been conducted with students at advanced levels of learning (e.g. Opolot-Okurut, 2005, 2010), thereby leaving knowledge gaps for the lower, and critical, age level. Moreover, understanding students' motivation towards maths as early as their first year of lower secondary school is important in designing early interventions to promote enjoyment and high achievement and avoid later disinterest in maths. Therefore, in the present study, using structural equation modelling (SEM), we examined the relationship between self-efficacy, value, anxieties, enjoyment and motivation in learning maths among students in year 1 of lower secondary school in Uganda.

Maths Education in Ugandan Secondary Schools

In Uganda, the secondary school maths curriculum is divided into (a) lower secondary school curriculum, taken by students from form 1 up to form 4, and (b) advanced secondary school curriculum, which is taken by students from form 5 to form 6. Maths is compulsory at lower secondary school (Karuku & Tennant, 2016) and affects the final grade awarded to students at this level. Among other goals, maths teaching in Uganda aims to: (a) enable learners develop an attitude of logical thought; (b) provide an understanding of basic mathematical concepts; and (c) enable learner's interpret and analyse everyday maths-related problems (National Curriculum Development Center, 2008). As Namukasa, Quinn and Kaahwa (2010) assert, the maths education curriculum in Uganda has 'a commercial, arithmetized, and algebrized focus, and is dominated by a landscape of practicing, testing, and examining compared to a landscape of investigation' (p. 3108).

Over the years, maths has remained one of the worst performing science subjects at lower secondary school in Uganda (Uganda National Examinations Board, 2016, 2017). For instance, in 2016, of the 314,597 students who sat for lower secondary examinations, 60.7% students scored grade 8 (which is next to a failure) in maths, and in 2015 this percentage was considerably higher (79.2%; Uganda National Examinations Board, 2017). Several reports have attributed students' poor achievement to low enjoyment, poor cognitive appraisals and anxiety, which in turn, result in low motivation for learning the subject (Opolot-Okurut, 2005).

Opolot-Okurut (2005) examined attitudes (i.e. anxiety, confidence and motivation) towards maths among 245 form 3 students selected from nine schools in Central Uganda. Results indicated low levels of motivation and confidence, and high levels of anxiety among lower secondary students in four poor-performing schools. The same study also indicated that female students had lower confidence beliefs, higher anxiety and lower motivation in maths compared with the male students. Results from this study indicated that students' attitudes and motivation towards maths vary according to students' school type and gender.

In 2012, at the second annual science teachers' conference organized by the National Association of Science Teachers in Uganda, it was noted that for all years, in science subjects (including maths), students who pass with grades between distinction 1 and credit 6 have never reached 50% (Abel, 2012). Low motivation was cited among the major causes of such low performances among students. Among other strategies, teachers were advised to make science more valuable and enjoyable by relating the study material to the learners' environments and experiences, encouraging peer learning, and making learning content more challenging.

Kiwanuka et al. (2016) examined the extent to which students' and classroom characteristics influenced attitudes (i.e. confidence, value, and enjoyment) towards maths in a sample of 4819 first-year secondary school students selected from Central Uganda. Preliminary results indicated that students' enjoyment in learning maths strongly and positively correlated with perceived usefulness ($r = 0.50$, $p < 0.01$) and self-confidence ($r = 0.54$, $p < 0.01$). This implies that students' enjoyment of maths is related to their cognitive appraisals (i.e. confidence and value beliefs). The same study also indicated a decline in students' cognitive appraisals and enjoyment of learning maths as early as the first year of lower secondary school.

Generally, the above studies have indicated that lower secondary school students' motivation and enjoyment in learning maths are highly influenced by their competence and value beliefs. Moreover, some of the studies have been conducted with students at advanced levels of learning (e.g. Opolot-Okurut, 2005), thereby leaving gaps in our understanding of the various factors influencing motivation of first-year secondary students towards learning maths. The present study, therefore, updates and extends previous studies that have examined attitudinal variables (e.g. enjoyment and anxiety) and the motivation of lower secondary school students in Uganda. We believe that each of the studies carried out along this line of inquiry brings us closer to a better understanding of the factors affecting motivation in maths learning among lower secondary school students in the Ugandan context.

Theoretical Framework

The present study was grounded in the control-value theory of achievement emotions (Pekrun, 2006; Pekrun & Stephens, 2010), which states that learners' achievement emotions are influenced by their cognitive appraisals of value and control. Achievement emotions are defined as 'emotions tied directly to achievement activities (e.g. learning) or achievement outcomes (e.g. failure and success)' (Pekrun, 2006, p. 317) and may differ according to the context (e.g. learning or assessment). In the present study, we examined emotions related to maths learning (such as enjoyment and learning anxiety) and maths tests (i.e. test anxiety). We focused on enjoyment and anxiety because of their high correlation with motivation (see Pekrun, 2006; Pekrun & Stephens, 2010).

Control appraisals refer to an individual's perceived causal influence over certain learning activities and outcomes, and they include retrospective attributions, prospective causal expectations (such as self-efficacy beliefs) and competence beliefs (such as self-concepts of ability). In the present study, we focused on self-efficacy as it is a strong predictor of maths motivation as documented in previous studies (e.g. Skaalvik, Federici & Klassen, 2015; Stevens, Olivarez, Lan & Tallent-Rumels, 2010). On the contrary, value appraisals concern the intrinsic value of an activity (e.g. innate pleasure of learning maths) and extrinsic values, in which an individual values an activity as it is likely to earn him external rewards such as recognition. In the present study, maths value was operationalized as the extent to which learners perceived learning maths to be helpful in their future education, daily life and career (Luo, Ng, Lee & Aye, 2016).

A combination of control and value appraisals evokes several achievement emotions including enjoyment and anxiety, among others. Pekrun (2006) further argues that achievement emotions influence learners' motivations in a given subject domain. For example, a learner who derives a lot of enjoyment from solving mathematical problems will have high motivation to learn the subject further. In the same perspective, a learner with high maths anxiety will have decreased motivation for learning the subject compared with those students with low anxiety.

It can, therefore, be hypothesized that cognitive appraisals (i.e. self-efficacy and value) influence learners' achievement emotions (i.e. enjoyment and anxieties), which in turn influence their motivation in learning maths (see Figure 1).

At this point, it is important that we state the operational definitions of the variables considered in the present study.

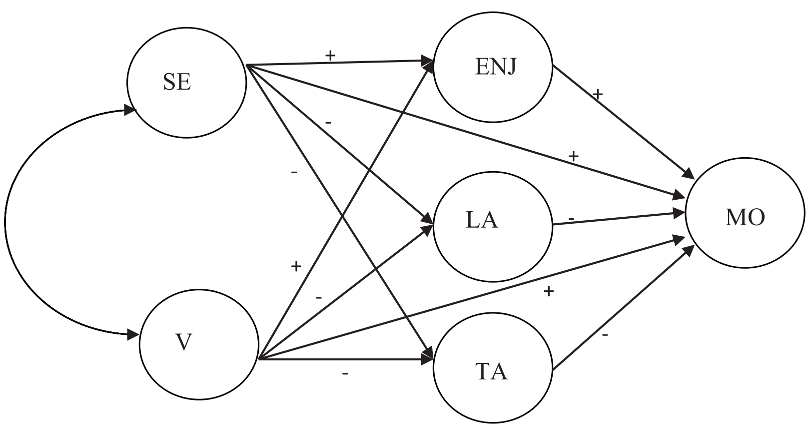

Figure 1. Conceptual model showing the structural relationships between the study variables.ENJ , Enjoyment; LA , learning anxiety; MO , motivation; SE , self-efficacy; TA , test anxiety; V , value. Negative sign indicates a hypothesized negative relationship between the variables. Positive sign indicates a hypothesized positive relationship between the variables

(1) *Maths self-efficacy*: Bandura (1997) defined self-efficacy as an individual's evaluation of whether he/she has the capabilities to complete a particular task. In the present context, students who believe that they possess the necessary skills and abilities to learn and succeed in maths would be considered to have a high maths self-efficacy. High self-efficacy has been associated with high maths learning motivation (Berger & Karabenick, 2011; Long, Monoi, Harper, Knoblauch & Murphy, 2007), low anxiety (Bandura, 1997; Pajares, 2003) and high enjoyment in learning (Pekrun & Stephens, 2010).
(2) *Maths value*: this refers to the perceived usefulness of maths in the students' day-to-day life and their future career and education (Eccles & Wigfield, 2002). Students who attach high value to maths enjoy it and are highly motivated to learn the subject (Pintrich & DeGroot, 1990; Villavicencio & Bernardo, 2013).
(3) *Maths enjoyment*: this is a pleasant emotion that arises when students find pleasure in doing maths-related activities (see Adelson & McCoach, 2011; Pekrun, 2006). In maths, enjoyment arises when students perceive that a given task is controllable and valued.
(4) *Maths learning anxiety*: this refers to the learners' worries and fears associated with the learning of maths. High anxiety in learning has been linked to low motivation, efficacy and task value beliefs (Pintrich & DeGroot, 1990) and shorter working memory span (Ashcraft, Krause, & Hopko, 2007).
(5) *Maths test anxiety*: this refers to the learners' worries and fears associated with sitting for tests and examinations in maths. High test anxiety has been linked to low cognitive appraisals and low motivation among students (Pintrich & DeGroot, 1990).
(6) *Maths motivation*: this refers to the tendency of learners to engage in learning maths because of the inherent interest and pleasure derived from working on mathematical problems (García, Rodríguez, Betts, Areces, & González-Castro, 2016). High motivation in learning results from high cognitive appraisals and pleasant achievement emotions (Pekrun, 2006).

Current Study

The present study explored the structural relationships of selected factors (i.e. cognitive appraisals, emotions and anxieties) potentially influencing maths motivation for students in form 1. We conceptualized the six study variables as latent variables and their respective items as indicator items. The study was guided by the following research question:

> what are the structural relationships between self-efficacy, value, anxieties, enjoyment, and motivation for learning maths among first year students in lower secondary schools in Uganda?

Methods

Sample

The population comprised approximately 1500 form 1 students from four urban secondary schools located in central and western Uganda. Krejcie and Morgan (1970) recommend selecting a sample size of 306 from a population of 1500; hence, through simple random sampling, we selected 306 students. Data from four students were excluded as they or their parents/guardians did not sign the consent forms; hence the final sample comprised 302 students with more male students (191 students, 63.2%). Many of the respondents were residing within the schools (223 students, 73.8%) while 73 students were residing outside the schools. Six students did not report their residence status. The age of the respondents ranged between 11 and 18 years with a mean age of 14 years (SD = 1.06). The selected schools followed a similar national maths curriculum released by the National Curriculum Development Centre of Uganda.

Procedure

We first sought permission from the school authorities of the respective schools to administer the questionnaires. We then contacted the maths teachers to ask for part of their lesson time for administering these questionnaires. The first author explained the aims of the study to the students before enrolling them into the study. Students were allowed to ask questions on issues where they needed clarifications.

Instruments

A self-report questionnaire comprising two sections was used to assess the study variables. The first section consisted of items about the students' demographic characteristics such as gender, age, residential status, father's education level and mother's education level. The second section consisted of six subscales that assessed students' motivation, self-efficacy, value, learning and test anxiety, and enjoyment in learning Math.

Maths motivation, value and enjoyment were assessed using several subscales adopted from the Attitudes towards Maths Inventory (Tapia, 1996) whereas maths self-efficacy was assessed using the self-efficacy subscale adopted from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991).Learning and test anxieties were assessed using the Abbreviated Maths Anxiety Scale (AMAS; Hopko, 2003). An initial confirmatory factor analysis supported the uni-dimensionality of the constructs assessed by different subscales. The composition of these subscales is described below.

A five-item motivation scale was used to assess students' motivation for studying maths. Two reverse-worded items (i.e. 'I would like to avoid using maths in school' and 'I like difficult maths numbers') were deleted; hence, we used only three items from this scale for assessing motivation (α = 0.71). Several authors (e.g. Distefano & Motl, 2006; Roszkowski & Soven, 2010) have argued against the use of negatively worded items in positively worded scales as it leads to ambiguity of results (Roszkowski & Soven, 2010). One of the retained items stated 'I plan to learn as much mathematics as I can during my education'. Self-efficacy was assessed using a six-item self-efficacy scale (α = 0.85). Some of the items on this scale included, 'I'm certain I can understand the most difficult material taught in maths', and 'I'm certain I can master the skills being taught in maths'. A nine-item value scale (α = 0.88) was used to assess students' value for studying maths. Some items on this scale included 'Maths helps to develop the mind and teaches a person to think' and 'I can think of many ways that I use maths outside school'. Enjoyment of maths was assessed using the 10-item enjoyment scale (α = 0.88). Some of the items on this scale included, 'I am happier in a maths class than in any other subjects' and 'I have usually enjoy studying maths in school'. The five-learning anxiety scale from the AMAS assessed students' worries related to learning maths. Since students at this level had not started using maths tables, we deleted one item ('Having to use the tables in the back of a maths book') from this subscale; hence, only four items (α = 0.68) were retained on this scale. Test anxiety was assessed using the four-item test anxiety scale from the AMAS. Since the item 'Being given homework of many difficult maths numbers and handing it in the next class lesson' assesses both test and learning anxieties (Cipora, Szczygieł, Willmes, & Nuerk, 2015), we deleted this item. The retained items had a reliability of α = 0.71.

Data Analysis

Data was analysed using SEM. Our analytic procedure followed three main stages: (a) data screening; (b) testing of the measurement model; and (c) estimation of the structural model, as described below.

Data screening

Following Teo, Tsai and Yang's (2013) recommendation, data were screened for (a) multicollinearity, (b) normality, (c) missing values and (d) sample size requirements. Some subscales' items had missing values of <1%, and hence we used the full information maximum likelihood for handling missing values, as it is more efficient and less biased compared with other techniques such as listwise deletion (Geiser, 2013). Following Kline's (2005) recommendation, all correlations between the variables were below 0.85 (see Table 1); hence, there was no multicollinearity among the study variables. Analysis indicated multivariate non-normality, and hence we used the maximum likelihood estimation with robust standard errors (MLR) in all our analyses. The MLR is very robust even for violations of normality (Geiser, 2013). A minimum sample of 200 has been recommended for SEM (Tomarken & Waller, 2005); hence, the sample of 302 students used in the present study was adequate for SEM analyses.

Testing of the measurement model

It is always advisable to examine the psychometric fitness of the model before fitting in the structural paths (Byrne, 2012), and this informed the second step. The structural model was estimated after obtaining an adequate measurement model. In case a given structural path was insignificant, it was removed and the model estimated again. This was done to come up with a parsimonious model which used fewer parameters to describe the relationships between the study variables. Since learners' cognitive appraisals, emotions and motivation vary with respect to their demographic variables such as gender (see Kiwanuka et al., 2006; Pintrich & DeGroot, 1990), we controlled for the effects of such variables in the structural model.

We evaluated model fits using the fit indices including the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR). We followed the model fit criteria suggested by Hu and Bentler (1999), who proposed CFI and TLI values greater than 0.90, SRMR $\leq$ 0.08 and RMSEA $\leq$ 0.06. All analyses were conducted in Mplus 7.4 (Muthén & Muthén, 1998–2015) since it is able to estimate multivariate models having both latent and manifest variables—as it was in the present study.

Results

Preliminary Results

Inter-factor correlations

All variables included in the study had significant correlations ranging between -0.27 and 0.80 (see Table 1). Significant positive correlations were found between self-efficacy, task value, enjoyment and motivation for learning maths. This implies that students who enjoyed learning maths attached a lot of usefulness to the subject, believed that they had the required competences to succeed in the subject and had high motivation to learn the subject. In line with previous studies (e.g. García et al., 2016), learning and test anxieties correlated negatively with self-efficacy, task value, enjoyment and motivation for learning maths, hence, high levels of worry in learning and sitting examinations were associated with low enjoyment of learning, low perceived usefulness of maths, low belief in one's competences and low motivation for learning maths. It is important to note that the correlation between learning anxiety and maths motivation was not statistically significant.

Measurement Model

Initial estimation of the measurement model indicated an adequate fit (CFI = 0.92; TLI = 0.92; RMSEA = 0.04; SRMR = 0.06) of the model with the data. All factor loadings of the indicator variables were significantly ($p < 0.001$) above 0.40 as recommended by Matsunaga (2010), indicating that these items were reliable indicators of the underlying latent variables.

Table 1. Inter-factor correlations

Variable	1	2	3	4	5	6
1. Self-efficacy	0.85					
2. Learning anxiety	-0.32**	0.68				
3. Test anxiety	-0.50**	0.68**	0.71			
4. Value	0.42**	-0.34**	-0.27**	0.88		
5. Enjoyment	0.63**	-0.39**	-0.56**	0.75**	0.88	
6. Motivation	0.48**	-0.28	-0.34**	0.80**	0.78**	0.71

** $p < 0.001$. Values written diagonally represent the Cronbach alphas for the subscale.

Structural Model

Fitting in the structural paths led to an adequately fitting model (CFI = 0.91; TLI = 0.90; RMSEA = 0.04; SRMR = 0.06) as indicated by acceptable fit indices. Inspection of the standardized parameter estimates of the output indicated that the following paths were not significant: (a) value to learning anxiety (β = -0.23, p = 0.138); (b) value to test anxiety (β = -0.11, p = 0.332); (c) self-efficacy to motivation (β = 0.05, p = 0.577), test anxiety to motivation (β = 0.03, p = 0.822); and (d) learning anxiety to motivation (β = 0.04, p = 0.703). Removal of the above paths led to a better model fit (CFI = 0.92; TLI = 0.91; RMSEA = 0.04; SRMR = 0.06). In the revised model (see Figure 2 and Table 2), self-efficacy (β = 0.41, $p < 0.001$) and value (β = 0.57, $p < 0.001$) significantly contributed to students' enjoyment of learning maths. Additionally, high self-efficacy was significantly associated with lowered students' learning anxiety (β = -0.35, p = 0.002) and test anxiety (β = -0.53, p = < 0.001). Lastly, value (β = 0.49, $p < 0.001$) and enjoyment (β = 0.42, p = 0.002) significantly contributed to students' motivation to learn maths. The results above imply that enjoyment partially mediated the relationship between students' task value and motivation to learn maths, whereas, it fully mediated the relationship between students' self-efficacy and motivation.

Indirect Effects of Cognitive Appraisals on Motivation to Learn Math

We then estimated the indirect effects of cognitive appraisals on motivation using asymmetric confidence intervals based on bias-corrected bootstrap methods. For a high precision, we chose a large number of bootstrap samples (i.e. 10,000). Estimates were interpreted at a 99% confidence interval, and we considered a given estimate to be significant if the lower and upper limits of the 99% confidence interval did not include the value of zero.

The indirect effect of self-efficacy (β = 0.17) was significant at the 1% level (see Table 2). This is because the 99% confidence intervals (0.048, 0.303) around the indirect effect did not include the value of zero. Additionally, the indirect effect of task value (β = 0.24) was significant at the 1% level as the 99% confidence intervals (0.030, 0.507) around the indirect effect did not include the value of zero. Overall, the model explained 12.4, 28.4, 69.5 and 72% of variance in students' learning anxiety, test anxiety, enjoyment and motivation for learning maths, respectively.

Discussion

We examined the structural relationships between students' cognitive appraisals (i.e. self-efficacy and value), anxieties, enjoyment and motivation for learning maths. Results indicated that enjoyment

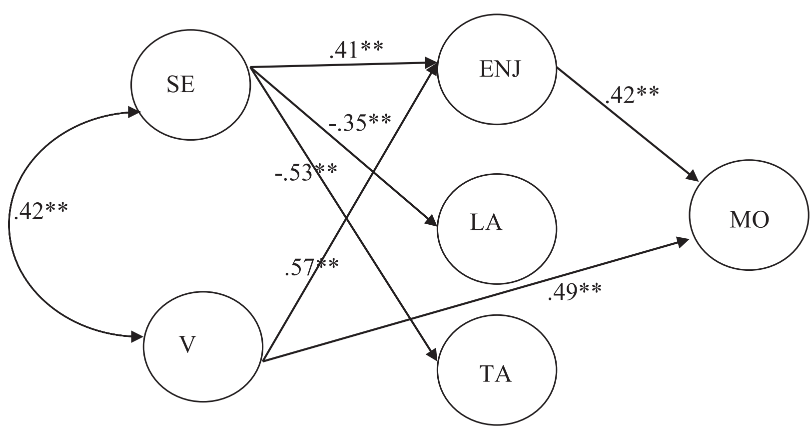

Figure 2: Structural model showing the structural relationships between the study variables.ENJ , Enjoyment; LA , learning anxiety; MO , motivation; SE , self-efficacy; TA , test anxiety; V , value. Only significant paths have been indicated in the model. Standardized parameter estimates are shown in the model. ** $p < 0.01$.

Table 2. Direct and indirect effects among the variables

Variables	Direct effect	Indirect effect	Total effect
SE → LA	-0.35**	—	-0.35**
SE → TA	-0.53**	—	-0.53**
SE → ENJ	0.41**	—	0.41**
V → ENJ	0.57**	—	0.57**
V → MO	0.49**	0.24**	0.73**
ENJ → MO	0.42**	—	0.42**
SE → MO	—	0.17**	0.17**

SE, Self-efficacy; LA , learning anxiety; TA , test anxiety; V , value; ENJ , enjoyment; MO , motivation. ** $p < 0.01$.

mediated the relationship between students' cognitive appraisals and motivation to learn maths. Consistent with previous studies (e.g. Pintrich et al., 1991), findings indicated that high cognitive appraisals were associated with low levels of learning and test anxiety among students. Contrary to previous studies (e.g. Cohen & Rubinstein, 2017), learning and test anxieties made positive contributions to students' maths motivation, although these were not statistically significant. Anxiety may be a powerful motivating force that propels people to engage in productive behaviours; hence, it may not be surprising that anxiety had a positive influence on students' motivation. For example, fear related to consequences of failure of tests would motivate students to attend maths classes regularly and complete their exercises on time.

Our findings about the mediation effects of enjoyment on the relationship between cognitive appraisals and students' motivation are consistent with the control-value theory of achievement emotions (Pekrun, 2006; Pekrun & Stephens, 2010). As discussed in the theoretical framework, achievement emotions such as enjoyment of learning maths arise when a learner is convinced that (a) (s)he has the required competences and abilities to learn the subject (i.e. high self efficacy beliefs) and (b) learning the subject is useful, say, in terms of meeting the societal needs or providing future employment. Further to this, high enjoyment of learning the subject will consequently strengthen the students' motivation and cognitive engagement when learning maths (Pekrun, 2006).

Implications of the Study

The results above imply that learners' motivation and enjoyment of learning maths could be strengthened by increasing their self-efficacy and task value beliefs. This has practical implications for the teaching of maths among lower secondary school students in Uganda.

First, learners should be advised to set up specific goals/targets to achieve during learning. For example, at the beginning of the term, the student may aim at scoring grade 1 in maths. With such an explicit target, a learner will initially feel a sense of motivation and efficacy to achieve it, expend a lot of effort, persist, attend classes regularly and regularly engage in academic tasks that lead to attainment of one's goal (Schunk, 1991). In maths, learners should set specific, challenging and proximal (close-at-hand; Schunk, 1991) goals, as these have been associated with increased motivation, self-efficacy and interest in learning maths in different intervention studies. Additionally, teachers should always give regular feedback to learners as they progress towards attainment of their goals through regular assessments, thus contributing to students' self-efficacy in maths. Additionally, as Bansilal, James, and Naidoo (2010) indicated, feedback increases learners' self-confidence beliefs in maths on top of keeping them on track as they pursue their goals. However, teachers should avoid providing negative feedback (e.g. criticising a learner for failing a maths test) as this lowers their efficacy beliefs and leads to less enjoyment, which lowers their motivation in studying maths (Bansilal et al., 2010; Kiwanuka et al., 2006). We also advocate the use of persuasion messages (e.g. telling the learner that she is more competent than the model) as this leads to higher efficacy beliefs and persistence (Warwick, 2008).

Value of maths could be enhanced by arranging mathematical concepts in such a way that they are optimally challenging, relevant and interesting to the learners. When learners view activities as being too simple, they become bored, while very difficult concepts can lead to anxiety (Deci & Ryan, 1985). Additionally, learning material will be valued if it is connected to the learner's previous knowledge and experiences (Dixon & Brown, 2012). For example, when teaching content about subtraction and addition in maths, the teacher should clearly articulate the applicability of addition and subtraction in the learner's daily life, say, in the buying and selling of goods in supermarkets. Therefore, teachers should emphasize the value of maths and education as this increases students' passion and motivation to learn maths which leads to improved maths achievement (Ruiz-Alfonso & León, 2017).

Additionally, a mastery approach of instruction that emphasizes exploration, curiosity and motivation (Shim, Cho, & Cassady, 2013) should be adopted by maths teachers, contrary to performance-oriented teaching, which is associated with deleterious effects on students' maths value (Anderman et al., 2001). Mastery-oriented classrooms in maths are associated with high intrinsic motivation (Murayama & Elliot, 2009) and high success expectancies and value of maths, high use of learning strategies and career plans in maths (Lazarides & Watt, 2015). Teachers are also advised to actively involve their learners in the teaching of maths and offer support to other learners, as this increases enjoyment of learning maths (Kunter et al., 2013).

Despite the above results, the study findings should be interpreted in light of some limitations as follows. First, the study employed a correlations study design; hence, causal inferences should not be drawn from the above study findings. Making such causal inferences would require carefully designed longitudinal studies. Second, data for the present study employed quantitative methods using a questionnaire to examine the relationships between the study variables. However, such self-report measures are vulnerable to social desirability (Dodaj, 2012), a situation in which an individual responds to items in such a way as to appear good. However, future studies can employ a mixed-methods approach in which quantitative findings are triangulated with qualitative findings. Lastly, the learning anxiety subscale had a relatively low reliability, evidenced by the Cronbach alpha below the cut-off point of 0.70. However, this subscale was retained since a lower internal consistency can still be acceptable (e.g. following a cut-off of 0.5 as suggested by Hinton, Brownlow, McMurray & Cozen, 2004).

Conclusions

The present study has highlighted the significant contributions of students' cognitive appraisals to their enjoyment and motivation towards learning maths among year 1 students of lower secondary school in Uganda. Additionally, the study has indicated the role of high self-efficacy and value on lowering students' test and learning anxieties. As suggested in the Discussion section, maths teachers should employ a number of approaches to increase learners' efficacy and value beliefs to promote enjoyment and motivation for learning the subject. Although the present study, to the best of our knowledge, is the first of its kind to examine the structural relationships between students' cognitive appraisals, achievement emotions and motivation for learning maths in the Ugandan context, it by no means exhausts all of the factors influencing motivation and enjoyment of learning maths. Researchers should therefore design more studies, especially longitudinal surveys to examine growth trajectories related to students' motivation towards learning maths in Ugandan secondary schools.

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References

Abel, J. (2012, October). *Poor performance of students in science examinations; The causes, implications and strategies to address the challenge*. Paper presented at 2nd Annual Science Teachers' Conference, Kampala,

Uganda. Retrieved from http://www.nastuganda.org/uploads/Reports/2nd%20Annual%20Conference-Report.pdf
Adelson, J.L., & McCoach, D.B. (2011). Development and psychometric properties of the Math and Me Survey: Measuring third through sixth graders' attitudes toward Math. *Measurement & Evaluation in Counseling & Development*, *44(4)*, 225–247.
Anderman, E.M., Eccles, J.S., Yoon, K.S., Roeser, R.W., Wigfield, A., & Blumenfeld, P. (2001). Learning to value mathematics and reading: Relations to mastery and performance-oriented instructional practices. *Contemporary Educational Psychology*, *26*, 76–95.
Ashcraft, M.H., Krause, J.A., & Hopko, D.R. (2007). Is math anxiety a mathematical learning disability? In D.B. Berch & M.M.M. Mazzocco (Eds), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 329–248). Baltimore, MD: Brookes.
Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.
Bansilal, S., James, A., & Naidoo, M. (2010). Whose voice matters? LEARNERS. *South African Journal of Education*, 30, 153–165.
Berger, J., & Karabenick, S.A. (2011). Motivation and students' use of learning strategies: Evidence of unidirectional effects in math classrooms*. Learning and Instruction*, *21*, 416–428.
Byrne, B.M. (2012). *Structural equation modeling with Mplus: Basic concepts, application and programming*. New York: Routledge.
Chouinard, R., & Roy, N. (2008). Changes in high-school students' competence beliefs, utility value and achievement goals in math. *British Journal of Educational Psychology*, *78*, 31–50.
Cipora, K., Szczygieł, M., Willmes, K., & Nuerk, H.C. (2015). Math anxiety assessment with the Abbreviated Math Anxiety Scale: Applicability and usefulness: Insights from the Polish adaptation. *Frontiers in Psychology*, *6*, 1–16.
Cohen, D.L., & Rubinstein, O. (2017). Mothers, intrinsic Math motivation, arithmetic skills, and Math anxiety in elementary school. *Frontiers in Psychology*, *8*, 1–17.
Deci, E.L., & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.
Distefano, C., & Motl, R. (2006). Further investigating method effects associated with negatively worded items on self-report surveys. *Structural Equation Modeling: A Multidisciplinary Journal*, *13*, 440–464.
Dixon, A.R., & Brown, R.A. (2012). Transfer of learning: Connecting concepts during problem solving. *Journal of Technical Education*, *24*(1), 2–17.
Dodaj, A. (2012). Social desirability and self-reports: Testing a content and response-style model of socially desirable responding. *Europe's Journal of Psychology*, *8*, 651–666.
Eccles, J., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*, 109–132.
García, T., Rodríguez, C., Betts, L., Areces, D., & González-Castro, P. (2016). How affective-motivational variables and approaches to learning relate to math achievement in upper elementary levels. *Learning and Individual Differences*, *49*, 25–31.
Geiser, C. (2013). *Data analysis with Mplus*. New York: The Guilford Press.
Hinton, P.R., Brownlow, C., McMurray, I., & Cozen, B. (2004). *SPSS explained*. London: Routledge.
Hopko, D.R. (2003). The abbreviated math anxiety scale (AMAS): Construction, validity, and reliability. *Assessment*, *10*, 178–182.
Hu, L., & Bentler, P.M. (1999). Cut-off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55.
Karuku, S. & Tennant, G. (2016). Towards a harmonised curriculum in East Africa. In A. Halai & G. Tennant (Eds), *Mathematics education in East Africa* (pp. 9–25). Dordrecht: Springer.
Kiwanuka, N.H., Van Damme, J., Noortgate, W., Anumendem, D.N., Vanlaar, G., Reynolds, C., & Namusisi, S. (2016). How do student and classroom characteristics affect attitude towardsmath? A multivariate multilevel analysis, *School Effectiveness and School Improvement*, *28*, 1–21.
Kline, R.B. (2005). *Principles and practice of structural equation modeling*. New York: Guilford.
Krejcie, R.V., & Morgan, D.W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, *30*, 607–610.
Kunter, M., Klusmann, U., Baumert, J., Richter, D., Voss, T., & Hachfeld, A. (2013). Professional competence of teachers: Effects on instructional quality and studentdevelopment. *Journal of Educational Psychology*, *105*, 805–820.
Lazarides, R., & Watt, M.G. (2015). Girls' and boys' perceived mathematics teacher beliefs, classroom learning environments and mathematical career intentions. *Contemporary Educational Psychology*, *41*, 51–61.
Long, J., Monoi, S., Harper, B., Knoblauch, D., & Murphy, P. (2007). Academic motivation and achievement among urban adolescents. *Urban Education*, *42*, 196–222.

Luo, W., Ng, P.T., Lee, K., & Aye, K.M. (2016). Self-efficacy, value, and achievement emotions as mediators between parenting practice and homework behavior: A control-value theory perspective. *Learning and Individual Differences*, *50*, 275–282.

Matsunaga, M. (2010). How to factor-analyse our data right: Do’s, dont’s and how to’s. *International Journal of Psychological Research*, *3*, 97–110.

Murayama, K., & Elliot, A.J. (2009). The joint influence of personal achievement goals and classroom goal structures on achievement-relevant outcomes. *Journal of Educational Psychology*, *101*, 432–447.

Muthén, L.K., & Muthén, B.O. (1998–2015). *Mplus user’s guide. v7.4*. Los Angeles, CA: Muthén & Muthén.

Namukasa, I., Quinn, M. & Kaahwa, J. (2010). School mathematics education in Uganda: Its successes and its failures. *Procedia—Social and Behavioral Sciences*, *2*, 3104–3110. doi: 10.1016/j.sbspro.2010.03.473

National Curriculum Development Centre (2008). *Mathematics teaching syllabus: Uganda Certificate of Education*. Kampala: National Curriculum Development Centre.

Opolot-Okurut, C. (2005). Student attitudes towards Math in Ugandan secondary schools*. African Journal of Research in Mathematics, Science and Technology Education*, *9*(2), 167–174.

Opolot-Okurut, C. (2010). Classroom learning environment and motivation towards math among secondary school students in Uganda. *Learning Environment Research*, *13*, 267–277.

Pajares, F. (2003) Self-efficacy beliefs, motivation, and achievement in writing: A review of the literature, *Reading & Writing Quarterly*, *19*, 139–158.

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review*, *18*, 315–341.

Pekrun, R., & Stephens, E.J. (2010). Achievement emotions: A control-value approach. *Social and Personality Psychology Compass*, *4*(4), 238–255.

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

Pintrich, P.R., Smith, D.A.F., Garcia, T., & McKeachie, W.J. (1991). *A manual for the use of the motivated strategy for learning questionnaire (MSLQ)*. Ann Arbor, MI: National Center for Research to Improve Post Secondary Teaching and Learning.

Roszkowski, M., & Soven, M. (2010). Shifting gears: Consequences of including two negatively worded items in the middle of a positively worded questionnaire. *Assessment & Evaluation in Higher Education*, *35*, 113–130.

Ruiz-Alfonso, Z., & León, J. (2017). Passion for math: Relationships between teachers’ emphasis on class contents usefulness, motivation, and grades. *Contemporary Educational Psychology*, *51*, 284–292.

Schunk, D.H. (1991) Self-efficacy and academic motivation. *Educational Psychologist*, *26*, 207–231.

Shim, S., Cho, Y., & Cassady, J. (2013). Goal structures: The role of teachers’ achievement goals and theories of intelligence. *The Journal of Experimental Education*, *81*(1), 84–104.

Skaalvik, E.M., Federici, R.A., & Klassen, R.M. (2015). Mathematics achievement and self-efficacy: Relations with motivation for mathematics. *International Journal of Educational Research*, *72*, 129–136.

Stevens, T., Olivarez, A., Lan, W., Tallent-Rumels, M. (2010). Role of mathematics self-efficacy and motivation in mathematics performance across ethnicity. *The Journal of Educational Research*, *97*, 208–222.

Tapia, M. (1996). *The attitudes towards math instrument*. Paper presented at the Mid-South Educational Research Association, November.

Teo, T., Tsai, T., & Yang, C. (2013). Applying structural equation modeling (SEM) in educational research: An introduction. In M. Khine. *Application of structural equation modeling in educational research and practice* (pp. 3–21). Rotterdam: Sense.

Tomarken, A.J. & Waller, N.G. (2005). Structural equation modeling: Strengths, limitations, and misconceptions. *Annual Review of Clinical Psychology*, *1*, 31–65.

Uganda National Examinations Board (2016). *Statement on release of 2015 UCE examination results*. Kampala: Uganda National Examinations Board.

Uganda National Examinations Board. (2017). *Statement on release of 2016 examination results*. Kampala: Uganda National Examinations Board.

Villavicencio, F.T., & Bernardo, A.B.I. (2013). Positive academic emotions moderate the relationship between self-regulation and academic achievement. *British Journal of Educational Psychology*, *83*, 329–340.

Warwick, J. (2008). Mathematical self-efficacy and student engagement in the math classroom. *MSOR Connections*, *8*(3), 31–37.

Wijsman, L.A., Warrens, M., Saab, N., & Van Driel, J.H., & Westenberg, M.P. (2015). Declining trends in student performance in lower secondary education, *European Journal of Psychology of Education*, *31*, 595–612.