An Investigation into the Motivational Beliefs and Mathematics Achievement Among Grade 10 Students

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Abstract

This study investigated Grade 10 students' motivational beliefs to learn mathematics as related to mathematics achievement. A total of 500 students of Grade 10 students from 2 high schools and 2 branch high schools of Indaw Township in Sagaing Region participated in this study. Descriptive research design and survey method were used. Based on Pintrich's social cognitive model, motivational beliefs (expectancy, value and affect) were conceptualized as self-efficacy, control of learning beliefs, intrinsic goal orientation, extrinsic goal orientation, task value and test anxiety. Two research instruments were used in this study. Firstly, Motivational Beliefs on Mathematics Questionnaire (MBMQ) modified from Motivated Strategies for Learning Questionnaire (MSLQ) designed by Pintrich, Smith, Garcia, & Keachie (1991) was developed. Secondly, to explore the students' mathematics achievement, researcher-made Mathematics Achievement Test was applied in this study. Findings from questionnaire surveys and tests revealed that students' mathematics achievement was significantly positively correlated with their motivational beliefs (r=0.15, p< .01). The ANOVA and Tukey HSD results also indicated that mathematics achievement of students in high motivational beliefs group were significantly different from that of low group and the students in middle group were significantly different from that of low group at 0.05 level. In other words, mathematics achievements of students from high and middle motivational beliefs groups are higher than that of students from low group. So, students who were high in motivational beliefs to learn mathematics had high achievement in mathematics. The results from this study suggested that it is needed to have high motivational beliefs to learn mathematics so as to improve students' mathematics achievement. Moreover, the teachers need to conduct enrichment activities that can enhance students' motivation in learning mathematics.

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Introduction

Without willingness or compulsion to do his task, one cannot pass through obstacles and achieve in it. Achievement outcomes have been regarded as a function of two characteristics, "skill" and "will" and these must be considered separately because possessing the skill alone may not insure success if the will is lacking (McCombs and Marzano, 1990). In the other words, only one who is intrinsically motivated can reach his selective goal which he sets for himself.

One of the most prominent academic problems plaguing teenage youths is a lack of motivation toward academic activities. Year after year, for reasons yet to be understood, numerous high school students find themselves in a state in which they do not have the desire to carry out the academic tasks required of them (Green-Demers & Pelletier, 2003). Indubitably, the absence of academic motivation can lead to feelings of frustration and discontentment and can encumber productivity and well-being.

So, Frith (1997) noted motivation as the internal derive directing behavior towards some end. Moreover, he also noted that external forces can influence behavior but ultimately it is the internal force of motivation that sustains behavior. People work longer, harder and with more vigor and intensity when they are motivated than when they are not.

Mostly, students try to make sense of novel learning situations by referring to their motivational beliefs. Motivational beliefs also refer to the student's opinion of the efficiency or effectiveness of learning and teaching methods. Beliefs about internal control can be distinguished into self-efficacy beliefs and outcome expectations. Self-efficacy beliefs are opinions that students hold about their own ability in relation to a specific domain. Outcome expectations are beliefs about the success or failure of specific actions (Boekaerts, 2002). In fact, motivation influences how and why people learn as well as how they perform.

According to Posamentier and Stepelman (1986), it can be true to say that skill in mathematics is the key to success in a great many of the most powerful and prestigious jobs in highly technical society. Mathematics improves creative thinking and reasonable power. The study of mathematics has also helped to increase the mental abilities of men.

Nowadays, mathematics holds a valued place in the academic curriculum; it is prominent on high-stakes measures of achievement generally used for level placement, for entrance into special programs, and for college admissions; and it has been called a critical filter for students in pursuit of scientific and technical career at the college level.

Many students are afraid of mathematics and will go to great lengths to avoid numbers and number operations. According to a research finding, while about 25 percent of an average class is in the re-teach group, only 10 to 15 percent of the class has chronic problems. All children can learn but some learn more slowly than others. The basic reasons are related to ability and motivation. Some children want to learn but seem to have difficulty in developing concepts. They are assumed to have low ability. Other students do not demonstrate a desire or need to learn mathematics. They are assumed to have low motivation. Both types are low achievers. However, the reasons why they are low achievers are different. Children in the first group lack ability. Children in the second group lack interest and motivation and are often referred to as under achievers (Underhill, 1981).

If so, what is the role of the teacher in learning? What is inescapable is that teachers cannot learn for their students. They can support learning in a variety of ways, but ultimately it is the learner who has to engage with the learning process. To do this, learners need to be motivated.

Students are very successful in hiding their thoughts and feelings, leading to misconceptions about their values, self-efficacy beliefs and outcome expectations. So, mathematics teachers should have a good idea of the motivational beliefs that their students bring into the classroom. Despite many investigations on mathematics subject, the issue of motivational beliefs and mathematics achievement has not yet been investigated in Grade 10 students in Myanmar. Therefore, the present study emphasizes to investigate motivational beliefs and mathematics achievement among Grade 10 students. Hence, this study will be able to highlight the ways and means of how to motivate students' ability for their achievement in every subject area associated with mathematical concepts.

Purpose of the Study

The main purpose of this study is to investigate motivational beliefs and mathematics achievement among Grade 10 students. The three specific objectives are as follows:

- To explore students' motivational beliefs on mathematics,
- To examine students' mathematics achievement and
- To find out the relationship between motivational beliefs (three motivational components) and mathematics achievement.

Related Literature Review

Pintrich's social cognitive model proposes three motivational components that may be related to academic achievement, namely: (a) an expectancy component, which refers to students' beliefs about their expected success in performing a task, (b) a value component, which concerns students appreciation of and beliefs about the importance of the task for them and (c) an affective component, comprised of students' emotional reactions to the task (Pintrich & De Groot, 1990). According to this model, motivational beliefs refers to the expectations, affect and values that students hold about objects, events or subject-matter domains and high level of motivation is the result of high achievement.

Although expectancy component has been conceptualized in a variety of ways in the motivational literature such as perceived competence, self-efficacy, attributional style, and control beliefs, this motivational component essentially concerns with students' answers to the basic question, "Can I do this task?" (Pintrich, 1990). Thus, the focus of the present study will be on self-efficacy and control belief. Bandura (1997) defined self-efficacy as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives". Control of learning belief refers to students' beliefs that their efforts to learn will result in positive outcomes. It concerns with the beliefs that outcomes are contingent on the amount of effort one puts in, in contrast to external factors such as the teacher.

Although there are a variety of different conceptualizations of value, two basic components seem relevant: goal orientation and task value. Pintrich, Smith, Garcia & McKeachie (1991) stated that goal orientation refers to the student's perception of the reasons why she is engaging in a learning task. Task value differs from goal orientation in that task value refers to the student's evaluation of how interesting, how important, and how useful the task is ("What do I think of this task?").

Again, there are a variety of affective reactions that might be relevant (e.g., anger, pride, guilt), but in a school learning context, one of

the most important seems to be test anxiety (Wigfield & Eccles, 1989). Test anxiety is an internal, nervous feeling that can occur through a combination of fears such as not succeeding, being embarrassed, and/or a feeling of being observed or evaluated. Therefore, Dornyei (1994) claimed that motivation influences the rate and success of learning and classroom teachers tend to consider learning motivation as the most important factor in advancing effective learning.

Empirical Studies in Motivational Beliefs on Mathematics. Siu-On (1998) applied Pintrich, Smith, Garcia and Keachie's (1991) Motivated Strategies for Learning Questionnaire (MSLQ) to investigate the relationship between motivational beliefs and mathematics achievement of Grade 9 Chinese students. Students' mathematics achievement was found to be significantly and positively correlated with self-perceived ability (expectancy) to learn mathematics and mathematics intrinsic motivation (value) and negatively correlated with mathematics anxiety. However, the results indicated that boys and girls did not significantly differ in mathematics achievement even though boys had higher motivational beliefs.

Moreover, House (2006) examined relationships between mathematics beliefs and achievement of elementary school-aged students in the United States and Japan. One result was that several mathematics belief variables were significantly related to mathematics achievement test scores for students in both Japan and the United States. Students in both countries who showed low mathematics test scores tended to indicate that mathematics was boring and to attribute success in mathematics at school to natural talent.

Tella (2007) investigated the impact of motivation on students' school academic achievement in mathematics in secondary schools. The study found that secondary school students differ significantly in their academic achievement based on the extent to which they are motivated. The result revealed that highly motivated students perform better academically than the lowly motivated students.

In sum, the above findings highlighted the importance of formulating achievement models that examine the associations among motivational beliefs and their links to mathematics achievements.

Design and Procedure

Sampling. Samples chosen for the present study consisted of 500 Grade 10 students: male (n=199) and female (n=301) in 2010-2011 Academic Year. A proportional random sampling technique was used in selecting students for the study. The participants for the study were chosen from 2 high schools and 2 branch high schools located in Indaw Township in Sagaing Region. Fifty percent of total populations from each school were randomly selected to test.

Research Method. In this study, descriptive research design and survey method were used. Questionnaires were used to solicit information on students' motivation in mathematical problem solving through a descriptive survey. For the quantitative study, Motivational Beliefs on Mathematics Questionnaire (MBMQ) which aimed to assess students' motivational beliefs to learn mathematics and mathematics achievement test which aimed to assess students' achievement in mathematics were implemented.

Motivational Beliefs on Mathematics Questionnaire (MBMQ). This was modified from Motivated Strategies for Learning Questionnaire (MSLQ) designed by Pintrich, Smith, Garcia, & Keachie (1991). The instrument was divided into two parts. The first part requires the participants' demographic information like sex, class, name of school, etc; while the second part contains items for motivational beliefs scale. This scale consists of 31 statements that are designed by three components (expectancy, value and affect) to assess students' motivational beliefs to learn mathematics. Specifically, expectancy component has two sub-scales: four items of control of learning belief and eight items of self-efficacy. Value component has three sub-scales: four items of intrinsic goal orientation, four items of extrinsic goal orientation and six items of task value. Then, affective component has only one sub-scale: five items of test anxiety. So, the questionnaire consists of 12 items to measure expectancy component, 14 items to measure value component and 5 items to measure affective component.

The scale of items in the questionnaire was 5 point Likert-scale ranging from agree to disagree. Twenty six items were positively stated while the rest were negatively stated. Positively stated items were scored on a five-point scale range from 1 (strongly disagree) to 5 (strongly agree). The scoring was reversed for negatively stated items. In this study, higher

scores on MBMQ indicate higher levels of motivational beliefs on mathematics.

Mathematics Achievement Test. A researcher-made mathematics achievement test was used to measure students' mathematics achievement. It was based on Grade 10 mathematics text in keeping with monthly syllabus of first semester (June to September) for determining how much Grade 10 student has learned. This test is a 35 item-multiple choice test and each item consists of five alternatives.

Data Collection. Participants were administered to complete Motivational Beliefs on Mathematics Questionnaire (MBMQ) during approximately 30 minutes. Participants were explained instruction on how to respond to the questionnaire and encouraged to ask questions during survey administration if they were unclear. After administering the questionnaire, the participants were asked to answer researcher-made mathematics achievement test for one hour.

Data Analysis and Results

An Analysis of Students' Motivational Beliefs. The participants' expectancy (control of learning belief, self-efficacy), value (intrinsic goal orientation, extrinsic goal orientation, task value) and affect (test anxiety) were investigated by the use of the 31-item Motivational Belief on Mathematics Questionnaire. First of all, the descriptive results for all 500 respondents were revealed in Table 1.

Table 1 Descriptive Statistics for Motivational Beliefs by Component

No.	Scales	No. of Items	Mean	Mean Percentage	Std. Deviation
1.	Expectancy	12	44.38	73.97%	6.271
2.	Value	14	56.07	80.1%	7.624
3.	Affect	5	12.88	51.52%	3.804
	Total	31	113.33		13.445

Table 1 shows that the mean and standard deviation for the whole sample are 113.33 and 13.445. The mean percentage of value component

(80.1%) was highest among three components and that of affective component (51.52%) was lowest among them. So, it can be concluded that students had high expectations on mathematics and low mathematics test anxieties.

Mean Comparison for Motivational Beliefs and Mathematics Achievement by Gender. To find out gender differences significantly in motivational beliefs and mathematics achievement, t-test was used. It was reported in Table 2.

Table 2 The Result of t-test on Students' Motivational Beliefs and Mathematics Achievement by Gender

Variables	*t*	*df*	*p*	Mean Difference
Expectancy Component	.480	498	.631	.275
Value Component	- .222	498	.825	- .155
Affective Component	2.196	498	.029	.760
Motivational Beliefs	.717	498	.474	.881
Mathematics Achievement	-3.375	498	.001	-1.903

Based on the result of t-test, there were no differences for students' expectations and values on mathematics by gender. But significant difference was found in mathematics test anxiety by gender ($p<.05$). Specifically, boys had more test anxiety scores to mathematics than girls. But, to sum up, the result of t-test on students' motivational beliefs by gender revealed that there was no gender difference.

However, there was significance difference in mathematics achievement by gender in this study ($p<.01$). To be specific, mathematics achievement of females were higher than that of males.

The Relationship Between Motivational Beliefs and Mathematics Achievement. The result of Table 3 shows that overall motivational beliefs was correlated significantly with mathematics achievement *(r* = .15, *p* < .01). But the strength of correlation was slightly weak. According to Cohen (1988), the effect size of motivational beliefs was smaller than typical to medium on mathematics achievement. Thus, motivational beliefs on mathematics had a medium effect on mathematics achievement.

Table 3 The Relationship Between Overall Motivational Beliefs and Mathematics Achievement

		Overall Motivation	Mathematics Achievement
Overall Motivation	Pearson Correlation	1	.15**
	Sig. (2-tailed)		.001
	N	500	500
Mathematics Achievement	Pearson Correlation	.15**	1
	Sig. (2-tailed)	.001	
	N	500	500

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

Again, to find out the relationship between three motivational components and mathematics achievement, multiple regression analysis was conducted.

Table 4 Results of Multiple Regression Analysis for Three Motivational Scales and Their Subscales as Predictors of Mathematics Achievement

Variables	β	t	F	p
1. Expectancy	.148	3.331	11.095	.001
Control of Learning Belief	.193	4.383	19.212	.000
Self-efficacy	.101	2.268	5.143	.024
2. Value	.152	3.433	11.787	.001
Intrinsic Goal Orientation	.153	3.466	12.012	.001
Extrinsic Goal Orientation	.120	2.694	7.256	.007
Task Value	.117	2.618	6.856	.009
3. Affect	- .014	- .308	.095	.759
Test Anxiety	- .014	- .308	.095	.759

Note: Dependent variable was mathematics achievement.

Table 4 revealed whether three motivational components and their subscales had significant relationships for mathematics achievement. Expectancy component was a positive predictor of mathematics achievement, $F(1,498) = 11.095$, $p < .01$, ($\beta = .148$) as well as value component, $F(1,498) = 11.787$, $p < .01$, ($\beta = .152$). But affective component was not significant with mathematics achievement, $F(1,498) = .095$, $p > .05$, $\beta = - .014$. So, affective component was not significant predictor of mathematics achievement whereas expectancy and value components were significant predictors of mathematics achievement. A pictorial summary for the results of the regression analyses were reported in Figure 1.

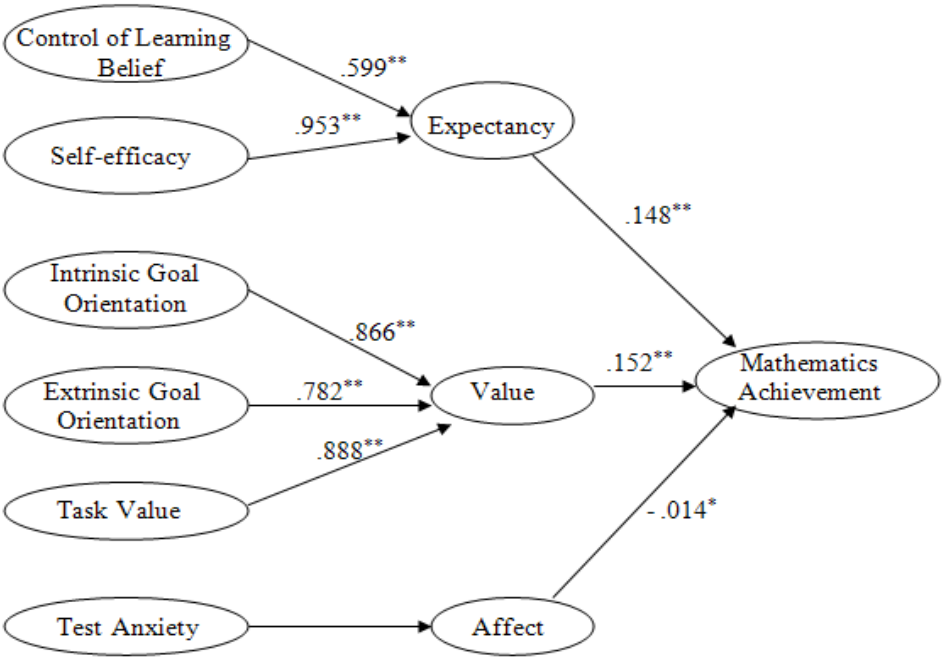

Figure 1 A Summary of the Results from the Regression Analyses. Path values are standardized regression coefficients. $^{**}p < .01$, $^{*}p > .05$.

The Differences in Mathematics Achievement among the Three Groups of Motivational Beliefs. To explore the differences of students' mathematics achievement among three groups of motivational beliefs, one way analysis of variance (ANOVA) was conducted. ANOVA results showed that there were significant differences in mathematics achievement among the groups at 0.05 level (see Table 5).

Table 5 ANOVA Results in the Differences among Groups

Mathematics Achievement	*df*	Mean Square	*F*	*p*
Between Groups	2	207.482	5.432	.005
Within Groups	497	38.173		

But, the F-ratio obtained in Table 5 indicated that at least one significant difference exist somewhere among three groups ($F_{(2,497)}$ =5.432, $p < .01$). To obtain more detailed information of which particular group had the differences, Post-Hoc test was executed by Tukey HSD method and it became apparent that the performance of the students in high motivational beliefs group was significantly different from that of low group at 0.05 level. Moreover, low motivational beliefs group was also significantly different from middle group. Significant difference was not found between high group and middle group (see Table 6).

Table 6 The Result of Tukey for Mathematics Achievement among Groups

Categories	(I) Motivation Group	(J) Motivation Group	Mean Difference (I-J)	*p*
Mathematics Achievement	High Group	Middle group	.315	.903
		Low Group	2.595*	.013
	Middle group	High Group	- .315	.903
		Low Group	2.280*	.006
	Low Group	High Group	-2.595*	.013
		Middle group	-2.280*	.006

* The mean difference is significant at the 0.05 level.

This result showed that the students who were high in motivational beliefs gained high mathematics achievement scores. Thus it is apparent that students' motivational beliefs have an effect on their mathematics achievement.

Conclusion

The main purpose of this study is to explore students' motivational beliefs to learn mathematics and their mathematics achievement. The responses in MBMQ, 5-point Likert Scale showed that mean score of Grade 10 students (Mean=113.33) revealed that their motivational beliefs to learn mathematics was remarkably satisfactory. Pajares (1994) stated that self-efficacy judgments of learners are linked to their achievement (as cited in

Hallam, 2005). Concerning this point, according to mean comparisons for motivational beliefs by three components, students also had high control of learning beliefs and self-efficacy (expectancy). So, it can be said that most of the students had beliefs to expend their effort to learn will result in positive outcomes. Besides, they also had high task value beliefs. According to Wigfield & Eccles (1997, cited in Tuckman, 1999), individuals will tend to do tasks that they positively value, that desire would be said that to provide incentive motivation for students to expend the effort. On the other hand, students had low anxiety when they took a mathematics test.

Gender Differences. Based on the result of t-test, in regard to gender differences, there were no differences in the structures of boys' and girls' responses to the expectancy scale and value scale, which indicates that they were equally concerned about expectations and values towards mathematics. However, boys reported experiencing more test anxieties on mathematics than did girls. Boys' stronger mathematics test anxiety might mean that mathematics courses get harder for them or they thought of the consequences of failing when they were taking mathematics tests.

To sum up, the result of t-test by gender revealed that there was no influence by gender on students' motivational beliefs to learn mathematics. On the other hand, concerning students' mathematics achievement, the result of t-test by gender revealed that there was significant difference at 0.01 level. So, the present results indicated that girls had higher mathematics achievement than boys even though boys and girls did not significantly differ in motivational beliefs to learn mathematics.

The Relationship Between Motivational Beliefs and Mathematics Achievement. Correlation analyses showed that students' motivational beliefs and their mathematics achievement were significantly correlated (r= .15, p < .01). But the strength of correlation was smaller than typical to medium. Thus, motivational beliefs on mathematics had a medium effect on mathematics achievement. In other words, it can be said that students who were high in motivational beliefs to learn mathematics had high achievement in mathematics. So, there was positive relationship between motivational beliefs and mathematics achievement.

For the relative contributions of the three motivational beliefs, multiple regression analysis was executed again. This analysis showed that two independent variables contributed significantly to mathematics

achievement: expectancy (β = .148) and value (β = .152). So, students' mathematics expectancy and value were the significant predictors of the mathematics achievement. In other words, there were positive relationships between these two components and mathematics achievement. Moreover, the standardized regression coefficient (β) and t-value of students' affect were -0.014 and -0.308. So, the correlation of affective component with mathematics achievement was not significant and there was no relationship between affective component and mathematics achievement.

To sum up, consistent with the previous studies (e.g., Siu On, 1998; House, 2006; Tella, 2007), students who got better results in mathematics had significantly more favorable expectancy and higher mathematics value. But students' mathematics anxiety did not influence on their mathematics achievement in this study.

Mathematics Achievement among Three Groups by Motivational Beliefs. To find out the differences of children's mathematics achievement among the three groups that were identified by their motivational beliefs, one way analysis of variance (ANOVA) was conducted. ANOVA results showed that there were significant differences in mathematics achievement among the groups at 0.05 level. Besides, Tukey HSD results indicated that the students in high motivational beliefs group were significantly different from that of low group at 0.05 level. Moreover, the students in middle group were significantly different from that of low group at 0.05 level. Significant difference was not found between high group and middle group.

Based on these results, it can be concluded that mathematics achievements of students from high and middle motivational beliefs groups are higher than that of students from low group. This result showed that the students who were high in motivational beliefs gained high mathematics achievement scores. Thus, students' motivational beliefs significantly affect their mathematics achievement.

Discussion and Recommendation

According to Pintrich (1993), a learning situation, for a learner, is not merely a mental performance but also a motivational challenge and an emotional coping situation. Motivation is the most overlooked aspect of instructional strategy, and perhaps the most critical element needed for

employee-learners. Even the most elegantly designed training program will fail if the students are not motivated to learn. Without a desire to learn on the part of the student, retention is unlikely (as cited in Jarvela & Niemivirta, 1999).

It is hoped that this research will provide a valuable insight into students' motivational beliefs to learn mathematics by investigating students self report information and results on mathematics test. Findings of this study showed that students were strong in mathematics goal orientation and task value. Moreover, their control belief and self-efficacy to learn mathematics were slightly strong. But, in this study, they had low anxiety to take mathematics tests. So, this study stated that students had above moderate motivational beliefs.

Based on research, the present study found that two motivational components (expectancy and value) and mathematics achievement had positive relationship whereas affective component and mathematics achievement had no relationship. Specifically, it can be said that the higher the control of learning belief, self-efficacy, goal orientation and task value, the better mathematics achievement. But students' mathematics achievement was not influenced by their test anxieties. That is why, sometimes test anxiety might be good impulses or drives for students to work hard and gain high marks in mathematics. Besides, Covington and Omelich (1987) stated that relationship of anxiety with motivation and performance is complex. High anxiety improves performance on simple, well-practiced tasks but lowers performance on new or difficult assignments.

To sum up, significant positive correlation was established between students' motivational beliefs and mathematics achievement. The findings support findings of Middleton and Spanias' (1999) study which concluded that success in mathematics is a powerful influence on the motivation to achieve. Moreover, this study can also establish whether high level of motivation is the result of high achievement or not.

So, to improve students' mathematics achievement, it is needed to have high motivational beliefs to learn mathematics. Students may be motivated to learn from an activity whether or not they find its content interesting or its processes enjoyable. Even if they may not get to choose the activity, they can choose to make the most of the learning opportunities it presents.

Based on the findings and all views discussed in the literature review, the following suggestions and recommendations were brought out as ways to improve the motivational beliefs to learn mathematics of Grade 10 students.

(1) The teachers need to reserve part of the class time to conduct activities that would develop enthusiasm in mathematics so that they can enhance students' motivation in learning mathematics.

(2) To improve students' control of learning beliefs and value, teachers can make the academic tasks more intrinsically valued by students and interesting by using novel or unexpected approaches to instruction. By providing students with a reasonable degree of control over their own learning, students can feel autonomous and self-determining.

(3) To improve students' goal orientation and self-efficacy, it is advisable for teachers to structure the curriculum and assignments in ways that maximize students' self-efficacy. Teachers can also make their instructional goals and objectives clear in order to create a positive expectation for success.

(4) To enhance students' motivational beliefs and mathematics achievement, students' anxiety should not be overlooked. Teachers can give clear, unambiguous instructions, an environment in which students do not feel threatened and a fair amount of structure in order to facilitate the processing of new information for anxious students.

(5) The teachers should make mathematics teaching interesting and individual differences in ability, background and attitude must be taken into consideration.

(6) To enhance students' motivational beliefs, teachers also need to be fulfilling by themselves with high motivational beliefs on subject matter.

(7) Special attention must also be given to the male students so as to reduce the gap in mathematics achievement between the male and female students.

The findings reported in this study justify the importance of motivation to academic performance. The findings have implications for the

mathematics teachers to motivate their students during the course of instructions. The parents as well as the authorities should engage in programmes that can motivate the students to improve their academic performance. It is therefore, hoped that these findings will serve as resource materials for mathematics educators, mathematicians, school authorities, psychologists, counselors, parents, teachers and significant others who are concerned with the academic progress of the students.

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