Original Research Article

Exploring the Relationship between Students' Attitude towards Mathematics and their Achievement in Mathematics

Abstract

Mathematics is underscored as a compulsory subject in schools of Bhutan but it has little impact on students by constantly showing poor achievement in mathematics. Thus, this study seeks to explore the relationship between grade six students' attitude towards mathematics and their achievement in mathematics. All the grade six students of Khoma Lower Secondary and Dungkhar Primary School were taken as samplessample for the study. A total of 50 students (26 female and 24 male) students were selected as samples following the convenience sampling technique. purposes comprising 26 female and 24 male students. The study adopted a descriptive correlational survey design with pure quantitative techniques. The data were gathered using ATMI (Attitude toward Mathematics Inventory (ATMI) developed by Tapia and Marsh (2004). Then theThese data collected were organized and analyzed using Statistical Package for the Social Sciences (22.0 version). Overall, the study disclosed that grade VI students have a high level of attitude towards mathematics with no significant differences between the attitude of male and female students towards mathematics. It was also found that there was a strong positive and significant correlation between students who have high achievement in mathematics and their attitude towards mathematics ($r = 0.634$, $p < 0.001$).

> **Comment [MOU1]:** The researchers need to restructure the findings to maintain clarity.

**Keywords:** achievement in mathematics, attitude, attitude towards mathematics, mathematics.

Introduction

Mathematics is the heart of science and its related courses, without mathematics, there is no real development in science and technology (Hafiz & Hina, 2016). The competence gained in the study of mathematics is widely known and used in all spheres of human life (Asiedu-Addo &Yidana, 2004). Realizing its importance, Mathematics has always been highlighted as a mandatory subject in the schools of Bhutan. However, research studies suggested, National Education Assessment [NEA],2003; Education without Compromise (2008), Annual Status of Student Learning (ASSL, 2008, 2010 & 2011): and The Quality of School Education in Bhutan (QSE, 2009): conducted by the Ministry of Education (MoE) and Royal Education Council (REC) among others, have demonstrated that the mandatory status of the subject has done very little to inspire and encourage Bhutanese students to endure the path of education in mathematics by consistently revealing the poor achievement in mathematics.

International studies such as the Program for International Student Assessment (PISA) and Trends in Mathematics and Science Study (TIMSS) have revealed Mathematics learning and achievement in students to be a global concern (Mohamed & Waheed, 2011). Students'

Attitude towards Mathematics (ATM) and its influence on~~towards~~ Mathematics achievement has been a topic of discussion for many mathematicians and educators. Later Ma and Xu (2004) also outlined in their study that poor achievement has been linked to a decline in Mathematics attitude. Hemmings and Kay (2010) have also found a significant association between Mathematics attitudes and achievement, and suggested that the attitude towards Mathematics can be a good predictor of Mathematics achievement (MA). It was further supported by different researchers agreeing that the learning outcomes of students are strongly related to their beliefs and attitudes towards mathematics (Furinghetti & Pehkonen, 2000; Leder, Pehkonen, &Törner, 2002). More recently, at Songkla province in Thailand, it was also found that there was a positive relationship between students' attitude towards learning mathematics and their achievement (Inkeeree1, Fauzeei, Othman, 2016). Therefore, students' attitude towards mathematics plays a major role that might influence the achievements of the students.

Problem Statement

During the 21 years of teaching experiences in different parts of Bhutan teaching various subjects such as Mathematics, English, Social studies and Value education, the teacher-researchers~~teacher researchers~~ have witnessed that many students possess a low level of interest in~~towards~~ mathematics although the subject is given topmost~~top most~~ priority in Bhutan. This is further ascertained by the Pupils' Performance Report (BCSEA, 2019 & 2020), which reported that the student's achievement in Mathematics in Bhutan Certificate of Secondary Education (BCSE) is comparatively lower than other subjects. BCSEA (2019) reported that the mean score of BCSE (Grade X) students in mathematics is 50.75% ~~only~~, with a similar pattern in 2020 (BCSEA, 2020) with 52.02% only. Moreover, Bhutan's PISA-D National Report (2019) revealed that Bhutanese students' achievement in mathematical literacy is at a poor level with only 38.84%. It is because children hold~~holding~~ negative mindset towards learning mathematics and show~~showing~~ less interest.

Many studies have examined factors that influence students' achievement in mathematics. One common factor identified to play a significant role was that of students' attitude towards the subject (Chamberlin, 2010). Subsequently, numerous studies have been conducted in different countries to ascertain the attitude level of students and to study the correlation between student attitude and academic achievement. However, the relationship between student attitude and academic achievement is inconclusive (Zan and Martino, 2007) since studies have revealed both positive and negative correlations.

Though there are a few studies~~researches~~ conducted in Bhutan to understand the cause of underachievement in mathematics, no research has been undertaken to understand the relationship between students' attitude towards Mathematics (ATM) and their achievement in Mathematics.

Therefore, the present study aims to fill in the gap of underachievement~~under achievement~~ in mathematics by better understanding the relationship between student's attitude towards mathematics and their achievement in the subject.

Literature review

The Royal Government of Bhutan has always given the education sector the highest priorities as the country's health, prosperity, happiness, and advancement depend on the quality of education. To reap this aim, the Ministry of Education has taken various reforms and initiatives to ensure that there are improvements in access, equity and system efficiency to improve the quality of education in the country. Over the years, Bhutan has made rapid progress in the education sector, which has immensely benefited the country from a generation of nation builders that the system has produced. However, the system still faces challenges in delivering quality education in STEM subjects. This literature review focuses on relevant research studies conducted internationally and within Bhutan on mathematics learning. It further talks about pertinent literature on the student's attitude towards mathematics.

Mathematics Learning in Bhutan

Mathematics is one of the most important and required subjects in Bhutanese schools in order to advance to the next grade. On the other hand, research studies such as the National Education Assessment (NEA, 2003); Education without Compromise (2008); Annual Status of Student Learning (ASSL, 2008, 2010 & 2011) and Royal Education Council (REC), have demonstrated that the mandatory status of the subject has very little impact to stimulate and motivate Bhutanese students to continue the path of education in mathematics by consistently revealing the underachievement~~under achievement~~ in mathematics. ~~It is obvious that,~~ Bhutanese children have had first-hand experience of learning mathematics in ~~the~~ Bhutanese classrooms. Most children still believe that mathematics is a challenging or boring subject ~~among all~~. Such belief has resulted in many educated parents and even teachers being willing to accept and tolerate low achievement in mathematics (Dukpa, 2015).

According to The National Education Assessment (2003), a standard study of Bhutanese student's achievement in numeracy and literacy undertaken by the Ministry of Education (MoE) with technical assistance of education experts from the Australian Council for Educational Research, disclosed that achievement in mathematics of grade six students to be "disappointingly low" with even the "academically better off children performing poorly." It also specified that "boys performed better than girls in numeracy" and those "who liked mathematics scored higher" (p.89).

Furthermore, the Education without Compromise (2008) document explicitly acknowledged the concerns expressed over a perceived decline in standards of education with particular reference to Mathematics, English and the Sciences (p.15). Some of the major recommendations made regarding mathematics were revision of the approach of math to free up curricular time for basic and foundational numeracy skills and allocation of greater proportion of resources to rural and remote schools (p.34). However, these strategies had very little impact. The findings of Bhutan's PISA-D National Report (2019), revealed that Bhutanese students have performed low in Mathematics literacy compared to Science and reading. This clearly demands new approaches and strategies.

Students' Attitude towards Mathematics and Achievement in Mathematics

Attitude is a sub-domain of affective science and differs from emotion, as it is more cognitive and stable than emotion (Goldin et al., 2016). Attitude also differs from belief, as it is less cognitive than belief. Students' attitudes toward mathematics are formed through their various experiences with mathematics (Davadas & Lay, 2017; Goldin et al., 2016). As accumulated experiences with a certain object and subject influence students' psychological state, they develop a positive or negative attitude toward such experiences. Moreover, students tend to behave and think in a certain way that matches their attitude. Knight (2005) divided attitude into three components as belief, emotional response and behavior and declares that attitudes are one of the important factors of achievement. This was further studied by Zan and Martino (2007) who distinguished between positive and negative attitudes by simply defining a positive attitude as a positive emotional disposition toward the subject, and a negative attitude as a negative emotional disposition toward the subject. Later Mata, Monteiro and Peixoto (2012) have mobilized a set of different definitions concerning attitudes by defining attitude towards mathematics as "a disposition towards an aspect of mathematics that has been acquired by an individual through his or her beliefs and experiences but which could be changed."

Many researchers have concluded that a positive attitude towards mathematics is one important factor for students to succeed in mathematics. Studies have found that there existsexist a positive relationship between students' attitudeattitude and the students' academic achievement (Mohd, Mahmood, and Ismail, 2011; Bramlettsnd Herron, 2009; Nicolaidou and Philippou, 2003; Papanastasiou, 2000; Ma and Kishor, 1997). Ma and Xu (2004) also outlined in their study that poor achievement in mathematics has a direct link to a decrease in mathematic attitude. Further, Hemmings and Kay (2010) have also found a significant association between mathematics attitudes and achievement, and suggested that the attitude towards mathematics can be a good predictor of mathematics achievement. However, this is not always true. Nga-Gan (1987) and Papanastasiou (2002) reported that there is no significant relationship between students' attitudeattitude towards mathematics and their achievement in mathematics.

Gender and Students' Attitude Towards Mathematics

Gender differences are a recurrent theme throughout the literature in academic studies in general and in math studies in particular. Math is often considered to be a domain in which boys are higher achievers, both in terms of attitudes and self-concept. Similar studies such as NEA (2003) and ASSL (2008, 2009, and 2010) conducted in Bhutan have also demonstrated that male students'student's performance in mathematics is significantly better than that of the female students.

Contrary to these, some studies have agreed that both gender students have a relatively positive attitude towards mathematics (Tezer & Karasel, 2010; Yilmaz et al, 2010; Fan, Quek, Yan, Mei, Lionel & Yee, 2005). Further, Abebe (2014) found that there was a significant difference in students' attitudeattitude towards mathematics in government schools while no significant difference was observed between male and female students on attitude.

Dukpa (2015) also revealed that there was no significant difference in the mean score between male and female students' attitude~~attitude~~ towards mathematics. In other words, the attitude of students towards mathematics did not depend upon gender, thus establishing that mathematics is neither a male nor female-dominated~~female dominated~~ subject in Bhutan.

On the contrary, there are studies such as the one conducted by Mahanta and Islam (2012) which showed that Rajasthani male students had more positive attitude towards mathematics than the female students and that the attitude and achievement were positively correlated. Even several international studies provided evidence that compared to boys, girls lack confidence in doing mathematical sums and view~~viewed~~ mathematics as a male domain (Meelissen & Luyten, 2008; Odell & Schumacher, 1998; Hyde).

Research Questions

1. What is the grade six students' level of attitude towards mathematics?
2. Is there a significant difference in the students' attitude based on gender?
3. What is the correlation between grade six students' ATM and achievements in mathematics?
4. What is the correlation between students' ATM and level of students' achievement in Mathematics?

Methodology

The study employed a descriptive correlational survey design with pure quantitative techniques. According to Emaikwu (2012), correlation survey is about establishing relationship between two or more variables. Hence, this design was appropriate in view of the conditions or relationships that exist between students' attitude and achievement in mathematics

Sample

The teacher researchers used convenience sampling techniques to select the research participants. All the grade six students of Khoma Lower Secondary and Dungkhar Primary School were taken as samples~~sample~~ ~~(for the study purposes comprising~~ 26 female and 24 male students).

Research Instrument

There are several attitude scales developed and used to measure students' attitude towards mathematics. However, for this study, the Attitude toward Mathematics Inventory (ATMI) survey questionnaire developed by Tapia and March (2004) was adopted to find out the level of students' attitude towards mathematics. According to Tapia and Marsh (2004), the Attitude toward Mathematics Inventory (ATMI) survey questionnaire was employed to evaluate different underlying perspectives of students' attitudes toward mathematics. The survey questionnaire has19 five-point Likert scale items: Strongly Disagree (DA), Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA) (Tapia & Marsh, 2004).These responses were assigned values ranging from 1 to 5 respectively.

Comment [MOU2]:

Comment [MOU3]: Are you finding the relationship between students' ATM and Achievement using the correlation analysis? If this be the case, your question should spell it out as "Relationship" not "Correlation". Thus, you may have to restructure the question.
Here is one suggestion: What is the relationship between grade six students' ATM and achievements in mathematics?

Comment [MOU4]: 1.What is the correlation between students' ATM and level of students' achievement in Mathematics?
2.The question may be changed as "What is the relationship between students' ATM and level of students' achievement in Mathematics?"

Similarly, the Mathematics textbook for grade six students "Understanding Mathematics" published by the Department of Curriculum Research and Development and Ministry of Education was used to prepare standardized questions to check students' achievement in mathematics. The researchers took special effort to prepare the achievement test questions which consist of fine content validity and generally met the requirement of teaching objectives.

The ATMI survey questionnaire was piloted to 35 grade six students from one of the schools outside the sample of the study to test the adequacy of the instrument by conducting a reliability and validity test. The Cronbach Alpha reliability score (α) of 0.86 was recorded. Therefore, the research instrument was reliable and valid to use in the study.

Similarly, achievement test questions were evaluated by five teachers (experts) teaching mathematics and certain changes and revision were done to some of the questions. After consulting the experts' opinions and doing the necessary revision, the questions were used to test for students' achievement in mathematics.

Data Analysis

The data collected were analyzed in the form of descriptive statistics and inferential statistics using Statistical Packages for the Social Sciences (SPSS 22.0).

The inferential statistics independent sample t-test with p<.05 level of significance, mean and standard deviation were used to check the significant difference of attitude towards mathematics between both genders. Moreover, correlation analysis was conducted to check the relationship between students' attitude and their achievements in mathematics. Similarly, the descriptive analysis on students' Attitude towards Mathematics was performed using mean and standard deviation. A total~~Total~~ of 19 five-point Likert items ranging from strongly disagree to strongly agree were administered to determine the attitude of grade six students toward mathematics. The mean scores from the questionnaires were used to determine the level of attitude based on the scale range shown in Table 1, calculated using the following equation:

$$Interval = \frac{Highest\ Level\ score - Lowest\ level\ score}{Number\ of\ Levels}$$

This score range was divided into 5 categories of attitude level: Very low, low, moderate, high and very high as shown in Table 1.

Table 1: Scale Range to determine the level of students' Attitude towards Mathematics

Mean score	Attitude Level
1.00 - 1.80	Very Low
1.81 - 2.60	Low
2.61 - 3.40	Moderate
3.41 - 4.20	High
4.21 - 5.00	Very High

Result

General Information of participants

Table 2 shows the general information of the participants for this study. 50 students of grade six from Khoma LSS and Dungkhar PS participated in the study. Of these 24 (48%) were male and 26 (52%) were female.

Table 2: *General information of participants*

Gender	Frequency	Percentage
Male	24	48
Female	26	52
Total	**50**	**100**

Students' Attitude Towards Mathematics

~~Research Question 1:~~

To evaluate ~~What is the~~ grade six students' attitude towards mathematics in KLSS & DPS, descriptive analysis (?

~~The students' attitude towards mathematics was analyzed using descriptive analysis of~~ mean and standard deviation) was computed~~.~~ T~~able.3 shows that t~~he mean score of female (*M*=3.34) and male (*M*=3.40) students are at a high level category (Table 3)~~as per the Table 1~~, with a very minimal mean difference of 0.06. Also, both the males (*SD*=0.38) and females (*SD*=0.33) have similar variability with a difference of 0.05. The high value of mean and low difference value of standard deviation suggests that both male and female students have a high level of attitude towards mathematics.

Table 3: Grade seven students' Attitude Towards Mathematics

	Gender	N	Mean	Std. Deviation	Std. Error Mean	Level of Attitude
Attitude Towards Mathematics	Female	26	3.34	0.33	0.04	High
	Male	24	3.40	0.38	0.05	High

~~Research Question 2: Is there a significant difference in the students' attitude towards mathematics and achievement in mathematics based on gender?~~

An independent sample t-test was conducted to find whether there was a significant difference between the male and female students' attitude towards mathematics (Table 4). The result indicated that there was no significant difference (t (138) =-1.154, $p > 0.05$) between female students' attitude towards mathematics ($M = 3.34$, $SD = 0.33$) and male students' attitude towards mathematics ($M = 3.40$, $SD = 0.38$). The magnitude of the difference in means (mean difference = -0.069, 95% CI: -0.18996 to 0.05) was very low. Hence, there is no significant difference in attitude towards mathematics in terms of gender of the students.

Table 4: *Independent samples t-test on attitude towards mathematics and gender*

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Attitude Towards Mathematics	Equal variances assumed	1.199	.275	-1.154	138	.251	-.06999	.06067	-.18996	.04998
	Equal variances not assumed			-1.120	105.923	.265	-.06999	.06248	-.19387	.05389

~~Research question 3:~~To examine the relationship between ~~What is the correlation between~~ grade six students' ATM and their achievement in mathematics, Pearson Correlation analysis was performed.~~?~~

As shown in Table 5, the Pearson Correlation between~~of~~ students' attitude towards mathematics and their achievement in mathematics was found to be slightly positive and statistically significant(r =0.2, $p<0.05$). This shows that students with a higher level of attitude towards mathematics tend to have better achievement in mathematics.

Table 5: *Correlation between grade seven students' ATM and achievement in mathematics*

		Students' Achievement in Mathematics	Attitude Towards Mathematics
Students' Achievement in Mathematics	Pearson Correlation	1	.200[*]
	Sig. (2-tailed)		**.017**
	N	50	51
Attitude Towards Mathematics	Pearson Correlation	**.200**[*]	1
	Sig. (2-tailed)	.017	
	N	50	51
*. Correlation is significant at the 0.05 level (2-tailed).			

~~Research question 4:~~Similarly, ~~—~~correlation analysis was computed to examine the relationship ~~What is the correlation~~ between students' ATM and level of their achievement in mathematics.~~?~~

Pearson Correlation between students' attitude towards mathematics and different level of achievement in mathematics was conducted. As shown in Table 6, it was found that students who achieved less than 60 in mathematics in the midterm examination had a low negative and statistically insignificant correlation ($p > 0.05$). However, it was also found that there was a very strong positive and significant correlation between the students who achieved above 80 in mathematics and their attitude towards mathematics ($r = 0.634$, $p < 0.001$). This clearly shows that students who achieve high in mathematics tend to have a higher level of attitude towards mathematics.

Table 6: Correlation between level of Achievement and ATM

		Attitude Towards Mathematics	Less than 40	40 to 59	60 to 80	80 and Above
Attitude Towards Mathematics	Pearson Correlation	1	-.419	-.120	.141	***.634***[**]
	Sig. (2-tailed)		.074	.342	.392	***.000***
	N	50	6	19	15	10
**. Correlation is significant at the 0.01 level (2-tailed).						

Discussion

This study revealed that there was a slightly positive and significant correlation between grade six students' attitude towards mathematics and their achievement in mathematics. This finding is in agreement with studies conducted by various researchers who found that there exists a positive relationship between students' attitude and the students' academic achievement (Mohd, Mahmood, & Ismail, 2011; Bramlett& Herron, 2009; Nicolaidou & Philippou, 2003; Papanastasiou, 2000; Ma & Kishor, 1997). It was further ascertained by Pearson correlation, that there exists a very strong positive and significant correlation between students' who achieved above 80 in mathematics and their ATM. This positive correlation demonstrated in the current study compliment the finding of the study by Mahanta and Islam (2012) that showed the positive correlation between students' attitude towards mathematics~~mathematic~~ and their achievement in mathematics.

Studies such as NEA (2003) and ASSL (2008, 2009, & 2010) conducted in Bhutan have demonstrated that male students' achievement in mathematics is significantly better than that of ~~the~~ female students. The study by Mahanta and Islam (2012) demonstrated that male students had more positive attitude towards mathematics as compared to ~~the~~ female students. However, this study found that there is no significant difference in the mean score and standard deviation between male and female students' attitude towards mathematics. Therefore, the attitude of students towards mathematics did not depend upon gender thereby

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establishing that mathematics is neither a male nor female-dominated~~female dominated~~ subject. This finding is similar to the findings of the study conducted in Bhutan by Dukpa (2015) who reported no significant difference in the mean score between male and female students' attitude towards mathematics. The finding also agrees with the study conducted in other contexts, for example, the study by Farooq and Shah (2008) in Pakistani context found no significant~~significance~~ difference between gender on the students' attitude towards mathematics.

Conclusion

Based on the findings of the study, it is concluded that the grade six students of Khoma LSS and Dungkhar PS have a high level of attitude towards mathematics. It further shows that there was a positive correlation between students' achievement in mathematics and their attitude towards mathematics. In addition, a strong positive correlation was observed between the students who have high achievement in mathematics and their attitude towards mathematics i.e. if students' attitude towards mathematics is~~be~~ increased then their achievement in mathematics certainly would increase. Further, it concluded that there was no significant difference between the attitude of male and female attitude towards mathematics.

So????

The study concludes abruptly without providing recommendations. Recommendations are considered the most important part of the analysis phase—this is where researchers suggest interventions or strategies to address the issues and constraints identified in the problem statement of the study based on the key findings arrived at through data collection and analysis.

> **Comment [MOU5]:** The whole research quest can be equated to finding the answer for 1+1=??? If the answer has no implication in the real-life situation. Therefore, the researchers should provide some recommendations based on the findings of the study.

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