RESEARCH PAPER

Factors influencing the performance of students in mathematics subject in the Bhutanese school education system

Kinzang Dorji *, Nandu Giri, Tandin Penjor, Sonam Rinchen

Department of Science Education, Samtse College of Education, Royal University of Bhutan, Bhutan

ABSTRACT

Mathematics is a compulsory subject in the Bhutanese education system and is a prerequisite subject to study science and business studies in the tertiary institutions. Low achievements in mathematics are a concern for the Bhutanese School Educational System. The purpose of this study was to investigate the factors responsible for the students' poor achievement in mathematics in the Bhutanese Secondary level Schools. The study revealed factors such as teachers' characteristics, curriculum design, lack of parental support and learners' perceptions towards subject are attributing to students' poor performance in the mathematics subject. It posits greater risk of prolonging the current declining trend of mathematics education if necessary interventions and innovative tools are not put in place. Therefore, the present study posits the collaboration as a rich and powerful learning space, where involvement of government policy makers, ministry of education as implementer, academic, teacher educators, and other educational stakeholders come together with different expertise that are conducive to the preparation of teachers and students for the 21st century education system.

Keywords: Bhutanese education system, Mathematics, learning space, Royal Government of Bhutan

1. INTRODUCTION

The Royal Government of Bhutan (RGoB) believes on the importance of mathematics as core subject in the school system. Bhutan has moved towards technological advancement which made mathematics a compulsory subject in the national school curriculum till grade X. In addition, Mathematics is also a prerequisite subject to study Sciences and Business studies in the tertiary institutions [1]. However, low students' achievement in Mathematics and other Science subjects has been deeply concerned by His Majesty the fifth King of Bhutan who considers "*the education of its citizen as strength for a small nation like Bhutan*" [2].

Despite the significant progress made in providing access and inclusivity to education, our graduates are inadequately prepared to enter the workforce. The paradox for Bhutan is on one hand Bhutan continues to face an acute shortage of skilled and specialized human resource in engineering and technical workforce but ironically the country is experiencing the high rate of unemployment crisis. In Bhutan students with a mathematics background have a better chance of employability and higher job prospects once employed. Students who dropped mathematics and science would find a fewer opportunities for higher studies and strife competition for employment. Consequently, less scientific skilled human resources will dampen the economy in a developing country like Bhutan [3].

There are four major factors that can be reason of poor mathematical skills. These factors are divided into Demographic Factors (e.g. gender, parent's educational level, and socio-economic status); Teacher Factors (e.g. teacher qualification and experience, teacher competency, and teacher-student ratio); Student Factors (e.g. students attitude and motivation); and Instructional Factors (e.g. pedagogy, curriculum, school environment, instructional materials and facilities).

Numerous demographic factors are identified to be related to student's achievement in mathematics. Gender, socio-economic status, and parents' educational level are factors that have been analysed in this study as predictors of mathematics achievement. Gender differences in mathematics could be attributed to their attitude and interest to mathematics, comfort level with certain topics, and pedagogy used by the teachers but not in understanding mathematics concepts [4]. Parent's involvement also affects the capability of fellow students.

Teacher competency in Mathematics education is directly associated with their instructional choices and activities [5]. Besides knowledge of the subject, teachers also need to have rich pedagogical knowledge. There is no denying fact that students' achievements in mathematics demand teachers to have a firm understanding of the subject domain [5].

Apart from teachers attitude towards teaching students response also affect their ability and performance in mathematics. It is observed in several studies that students who devote more time and efforts in the learning process derive greater achievement and satisfaction with their educational experiences and are more likely to continue their learning. Therefore overall achievement of students depends on a positive attitude towards mathematics [6]. Students with low level of positive attitude get low marks in their test as compared to students with high positive attitude [7].

Many concerns have been emphasized globally about the existing mathematics curricula that stress mostly on the process of calculation and computation with very little room for thinking, creativity and innovation [8]. The concerns are not that students should not learn to compute, but that students must learn how to critically analyse mathematical problems and produce effective solutions. This requires them to learn, how to make sense of complex mathematical concepts. Therefore, the purpose of the present

study was to investigate the impeding factors responsible for the students' poor achievement in mathematics in the Bhutanese Secondary Schools.

2. MATERIALS AND METHODS

2.1. Research Design

This study was grounded on the convergent parallel mixed methods approach [9]. The quantitative data were collected by administering the survey questionnaires to select students and teachers. The qualitative data were collected by interviewing select students, teachers, parents and principals via zoom meeting. Gathered data were merged, compared, related, analysed and outcomes were interpreted.

2.2. Survey questionnaires

Survey questionnaires was comprised of two sections A and B. Section A contained the demographic information of the respondents and Section B contained three sub-sections based on the variables of interest to be investigated. Since quantitative data collection involved collecting numerical data, the questionnaires in Section B were developed based on 5-points Likert scale (1-Strongly disagree; 2-Disagree; 3-Neither agree nor disagree; 4-Agree; 5-Strongly agree). Data collected from this tool were used to address the overarching research question of this study.

2.3. Semi-structured interview

In this study, face to face semi-structured interview was conducted for the selected students, and data were used in addressing research sub-questions 1, 2 & 3. In addition, the interview questions were developed according to variable of interest (i.e. student's attitude towards Mathematics) to get deeper insights of valid and reliable data that aided in addressing the above research sub-questions. Prior to the interview, consensus was sought from all participants for the interview and audio recording.

2.4. Data analysis

All qualitative data were subjected to thematic based content analysis in an attempt to seek deeper insights and opinions of participants on the research problem. Therefore, data transcriptions, coding or indexing were the important steps of qualitative data analysis and computer software NVivo was used to generate codes since manual coding was time-consuming and expensive. Similarly, quantitative data were subjected to statistical analysis using the IBM SPSS Statistics 22 program. Descriptive analysis were performed as a choice of first level of analysis that helped researcher to summarize the overall data. Correlation tests were run to explore the relationships between students' academic performance in Mathematics and the variables of interest. Variables of interest include students' belief and self-concept towards Mathematics achievements

3. RESULT AND DISCUSSION

3.1. Demographic details

Total 200 student participants were involved in this study from grade X and XII from six different schools under Samtse Dzongkhag (district) of Bhutan. These schools include three Middle Secondary Schools (MSS) and three Higher Secondary Schools (HSS). Sample size

Table 1. Students' Demographic information

Name of School	Male	Female	Total	%
Gomtu MSS	17	15	32	16
Dorokha MSS	18	16	34	17
Yoeseltse MSS	16	18	34	17
Samtse HSS	18	14	32	16
Pelzorling HSS	22	16	38	19
Tendruk HSS	19	11	30	15
Total	**110**	**90**	**200**	**100**

comprised of 55% (n=200) male students and 45% (n=200) female students (Table 1). Qualitative data were garnered by interviewing ten students (five each from grade X and grade XII), six mathematics teachers, three principals and five parents.

It was generally perceived that males have more affinity toward mathematics than females with few exceptions. However, recent study has reported that gender differences in mathematics education seem to be narrowing in many countries [10]. For instance, Kiptum (2013) posits that in the classroom situation, females prefer to use conversational styles that foster group work where there is sharing of ideas and learning from each other cooperatively [11]. Conversely, males learn through argument which foster competitive spirit. Study also indicates that as students progressed to higher grades, male students did better in mathematics [10]. The gender differences provide evidence that gender issues impact achievement in mathematics. Hence, it is crucial for educators and researchers to pay attention to gender differences in the design of mathematics instruction.

3.2. Student's perception of mathematics as a subject

The qualitative data revealed that majority of the students perceive mathematics as integral for science subjects, while some believe that mathematics is an interesting subject, and other minority perceives that it provides better job prospects in future.

Most of the students were also aware that mathematics is a prerequisite to become an engineer and for that they need to put a lot of efforts as voiced by Students.

"*I want to take mathematics in class XI because mathematics is fundamental in science related career. I want to become an engineer for which, mathematics is mandatory*".

Another student wanted to pursue mathematics in grade XI as mathematics is his subject of interest and it will help him develop cognitive skills:

"*Yes, I will pursue math in grade XI because math is an important subject, it helps me to build up my cognitive skills and it is a subject of my interest*."

The above views are supported both by parents and school principals. For instance some parents stated that "*mathematics is an important subject and it is a background for higher science studies*" and "*Mathematics should be part of school*

subject because if children want to pursue engineering related fields mathematics is compulsory".

It was also evident from the quantitative data that the students have higher self-concept on mathematics as a school subject and their self-concept commensurate well with their performance in mathematics exam. For instance, with the Spearman's rho coefficient (r) of 0.441 and p-value=0.000, a significant positive correlation was observed between students' performance in mathematics scores and self-concepts (Table 2).

Similarly, the correlation coefficient test also confirms the statistical significant (r=0.201; p=0.000) between students' performance and beliefs on mathematics as a school subject (Table 3).

The study revealed that the overall students' perceptions towards mathematics as a school subject were found to be positive. The information established from qualitative data confirmed that the majority of the students perceive mathematics as integral for science subjects, while some believe that mathematics is an interesting subject, and others feel that it provides better job prospects in the future. Similarly, information derived from the quantitative data also showed significant positive correlations at 95% confidence level for the variables such as student self-concepts and beliefs relative to students' mathematics performance based on mid-term and comprehensive final exams scores (based on 100 marks).

The study's result is consistent with other study by Mutodi, P., & Ngirande, H. (2014) that reported students' self-concept and beliefs were significantly associated with the students' high

Table 2. Spearman's rho correlation coefficient between students' academic performance and self-concepts

Correlations				
			Performance	Self-Concept
Spearman's rho	Performance	Correlation Coefficient	1.000	.441**
		Sig. (2-tailed)	.	.000
		N	200	200
	Self-Concept	Correlation Coefficient	.441**	1.000
		Sig. (2-tailed)	.000	.
		N	200	200
**. *Correlation is significant at the 0.01 level (2-tailed).*				

Table 3. Spearman's rho correlation coefficient between students' academic performance and students' beliefs

Correlations				
			Performance	Belief
Spearman's rho	Performance	Correlation Coefficient	1.000	.201**
		Sig. (2-tailed)	.	.000
		N	200	200
	Belief	Correlation Coefficient	.201**	1.000
		Sig. (2-tailed)	.000	.
		N	200	200
** *Correlation is significant at the 0.01 level (2-tailed).*				

performance in the examinations [12]. Positive perception can stimulate students' critical thinking, enhance active participation, and encourage students to learn the subject better.

Therefore, in this study, positive students' perceptions tended to indicate an important factor in contributing the high performance in mathematics among students. However, several other potential factors have existed that are associated with poor performance of students in mathematics in this study.

3.3. Teacher factors

"*As a principal, I consider mathematics as a very important subject because in the 21st century when the world is getting digitized someone cannot survive without mathematics. I can definitely say this as a teacher, principal, parent and as senior citizen. Now these days one cannot survive without mathematics background. Mathematics is one of the very important subjects that should be considered by the Ministry of Education, and must be made as a core subject in grade XI and XII*". This statement was given by Principal of participating schools.

The analysis indicated that student's experience shortage of mathematics teachers in the schools. The student's proficiency in mathematics is mainly attributed to teacher shortages in the schools and non-mathematics teachers teaching mathematics as evident from the interview data. "*My mathematics teacher left for her home country (India) in the middle of the academic year. We were studied without mathematics teacher for three months. On repeated request from grade XII students to the school principal, he arranged one teacher from a neighbouring school. Sometimes two grades are combined for the class due to teacher's shortage. I find it boring as the class is so congested and we can't concentrate*".

The above view is supported by Teacher who expressed, "*As far as my knowledge, there is a shortage of mathematics teachers across Bhutan. The fact is that we have less Bhutanese mathematics teachers and rely mostly on the experts from India. Lately, many Indian teachers are leaving after having served Bhutan for many years. Even in my school few months back one of the teachers left school and we did not get his replacement. So we were asked to fill their place by increasing our workload*".

Similarly, one of the Principal who took part in this study also resonated with the opinion that student's poor performance in mathematics could be due to non-mathematics teacher teaching mathematics as he expressed below.

"*We do not have enough mathematics teacher in our country. We even make other subject teachers to take mathematics and that could be one reason which hampers the performance*."

Heavy teaching load was cited as another reason by majority of the teacher respondents. "*Teachers are not doing justice to their profession as they seldom check students work and fail to understand where the students go wrong*".

Studies have shown that teacher experience is a major determinant in students' academic performance. However, other study also contends that the positive correlation between the numbers of year teachers taught with

students' performance is not always significant [13].

Besides heavy teaching load, teachers are also made to shoulder administrative responsibilities such as club coordinator, class teacher, games and sports in-charge, house adviser, exam in-charge, school time table coordinator, etc. These extra responsibilities are said to be inhibiting them to carry out quality teaching and assessment. One of the participating teachers expressed their situation by stating, "*When there are lots of extra responsibilities, teachers have to leave classroom in the middle of teaching and go for the other work. Therefore teachers cannot give proper feedback to the students that enables students learn better. We also cannot do the correction properly, so we cannot do proper assessment*".

Similarly, other teacher expressed, "*It definitely affects sir. Sometimes I have to leave my class and go to attend to exam related matters as I look after exam cell and also house master. At times we think too much about the work and we get distracted and we are not able to focus on the task*".

In support of the above statements one of the participating Principal voiced, "*Teachers are overburdened in the schools. They shoulder various responsibilities besides teaching, so enough teachers should be hired in the schools to share workload*."

Similarly, the quantitative data revealed that teachers seldom discuss practical problems in mathematics class, lack one to one guidance, occasionally correct their homework and provide constructive feedback, lack variation in pedagogies used and rarely comes prepared for the lesson as evidenced from a low mean value of 2.06 and SD=1.01 (table 4). This may attributed to the fact that teachers are burdened with heavy teaching load besides shouldering extra responsibility. It was also evident that B.Ed. teachers are not that confident in teaching mathematics. This was expressed by the students, principals and school teachers. Most of the student respondents expressed that B.Ed. teachers lack mathematics content and confidence to teach mathematics particularly at

Table 4. Illustration of the mean, standard deviation and students' level of opinion towards teacher's pedagogical practices.

SN	Items	N	Mean	SD	Level of Opinion
1	My teacher discusses practical problems while teaching mathematics	200	2	1.02	Disagree
2	My teacher uses examples from everyday life in solving math problems	200	2.08	1	Disagree
3	We are often made to work together in pairs or small groups	200	2.26	1.02	Disagree
4	My teacher discusses corrected homework in the class	200	2.15	1.01	Disagree
5	We have to work on math projects	200	2.86	1.23	Neutral
6	My teacher adopts different teaching methods while teaching mathematics	200	2.18	1.01	Disagree
7	My teacher comes prepared to the class all the time	200	1.6	0.79	Disagree
	Mean		**2.16**	**1.01**	**Disagree**

Level of opinion: 1-1.50 strongly disagree; 1.51-2.50 disagree: 2.51-3.50 neutral; 3.51-4.50 Agree; 4.51-5.00 strongly agree [14]

the higher secondary level. The student respondent said, "*Bhutanese teachers are not confident sir. They hesitate to teach as their content knowledge is low. Teachers should be trained and well versed with mathematics contents. The school management should monitor teachers teaching and check the performance of students. For class X and above well experienced teachers should be placed especially for mathematics and science and not fresh teachers so that the mathematics and science results of Bhutanese students are good*".

The quantitative data also confirms that the B.Ed. teachers' mathematics content knowledge is shallow with a low mean value of 1.83 (disagree) with SD 0.87 (Table 5).

The views of students, school mathematics teachers, principals and parents were sought to find out teacher characteristics in relation to teaching mathematics in the sample schools. Study revealed that mathematics teaching performance in the schools is associated with mathematics teacher shortage, teaching mathematics by non-mathematics teachers, heavy teaching loads, and other extra administrative responsibilities shouldered by the mathematics teachers, suggesting potentially important explanation factors that accounted for low performance of Bhutanese students in mathematics. Several studies have shown that teacher effectiveness in terms of content and concept delivery positively influences the students' performance in mathematics [15]. Similarly, a study indicates that mathematics subject and its teaching requires variety of instructional methods to facilitate fruitful learning and result [16]. It develops maximum student's understanding and knowledge of the mathematical concepts. Further analysis of teacher characteristics data also revealed that mathematics teachers with B.Ed. qualifications were observed with weak mathematical content knowledge in this study, indicating that qualification of mathematics teachers is highly perceived by students as one of the important determinants of their success in mathematics learning. Consequently, this finding poses some key questions to be addressed by the initial teacher preparation colleges for revisiting the teacher preparation programmes and government agencies to relook at the pre-service teacher candidate selection process if quality of education system is intended to benefit our future teachers and the performance of mathematics in the schools. Several other studies have confirmed that the mathematical understanding required for quality education is a specific professional knowledge that can be acquired in university training and developed

Table 5. Students' opinions on B.Ed. teacher's mathematics knowledge.

SN	Items	N	Mean	SD	Level of opinion
1	My teacher has a very good mathematics content knowledge	200	1.54	0.75	Disagree
2	My teacher relates mathematics to a real life situation	200	2.45	1.15	Disagree
3	My teacher is not confident in teaching mathematics	200	1.50	0.73	Disagree
	Mean		**1.83**	**0.87**	**Disagree**

through reflections on teaching practices [17].

Therefore, the present study suggests some acquaintances between teacher characteristics and student performance that is important for education policy to align with initial teacher preparation programmes to provide best pre-service training of mathematics teachers to equip them with required skills for teaching mathematics in secondary schools. Ensuring that pre-service teachers who are best suited and most able to enhance student performance are key responsibilities for policy makers and implementers.

3.4. Student factors

Students' poor performance in mathematics is related student characteristics such as large class size, lack of mathematics foundation in lower grades, consider mathematics as a secondary subject and difficulty level of some mathematics topics.

Majority of the teachers mentioned that they face problems in organizing learning activities in the class because of big class size and congested classroom situation. As one teacher expressed, "*It's very difficult to manage a class of 45 students. It is very congested. We even don't have enough space to walk in the class and attend to individual students*."

Similar views were expressed by the respondent students, "*It is difficult for them to pay attention to mathematics in the crowded and noisy classroom*."

The analysis of teachers' quantitative data also showed that the teachers strongly agreed with a mean value of 4.70 and SD 0.48 that owing to large student numbers they are not able to give one to one guidance, correct their classwork on time and provide constructive (Table 6).

A student-teacher ratio is about 40:1 in Bhutanese schools. It may be considered adequate but the situation is far from this. A study by Umameh (2011) in Nigeria suggested that a single class in Nigeria is occupied by 50 students. Under such condition, the teacher cannot perform effectively due to overcrowding and solving one to one problem become time taking and tedious. Moreover, marking assignments and test papers becomes tiresome while compilation of results becomes a frustrating exercise. This culminates to students' poor performances in mathematics examination [18].

Most of the students fail to cope up with mathematics in higher grades. The reason was

Table 6. Illustration of the mean, standard deviation and teacher's level of opinion towards large class size.

SN	Item	Mean	Std. Deviation	Level of Opinion
1	Teachers are not able to give one to one guidance because of overcrowded classroom.	4.73	0.467	Strongly Agree
2	Teachers are not able to correct students homework/ classwork on time owing too large class size	4.73	0.467	Strongly Agree
3	Teachers are not able to provide constructive feedback to students work due to large class size	4.64	0.504	Strongly Agree
	Total	**4.70**	**0.48**	**Strongly Agree**

mainly attributed to their poor mathematics foundation at lower grades. As the respondent student expressed, "*Students lack basic knowledge in mathematics from lower grades itself, so they fail to perform better in mathematics as they reach higher grades. In my case, I was not good in mathematics in lower grades as my teacher failed to motivate me. For me the turning point was in grade VIII as my teacher was strict and I started developing interest from grade VIII.*"

Mathematics education requires highly motivated students because it requires high level reasoning, making interpretations, and solving problems [3]. In this context, few works examined the relationship between classroom motivation and academic achievement in elementary-school-aged children. They found that motivation was related to a higher level of mastery in mathematics.

The teacher's role in students' motivation to learn should not be underestimated. In helping students become motivated learners, the teacher's main instructional task is to create a conductive learning environment where students can engage in mathematical thinking activities and see mathematics as something requiring exploration, conjecture, representation, generalization, verification, and reflection [19].

3.5. Curriculum

The present study also reveals that mathematics curriculum needs to be relooked in the areas such as progression of mathematics content from lower grades to higher grades and vastness of the syllabus particularly in grade XI and XII textbooks.

Majority of the respondents expressed that though there was a good progression in mathematics content from lower grades to grade IX and X textbooks but witnessed a big shift in grade XI and XII. For instance, the students, teachers, and parents reported that mathematics becomes extremely challenging after grade X as there is no progression of topics in grade XI and XII as expressed below:

"*There is no connection between grade X mathematics with grade XI and XII mathematics. We studied Bhutanese (many refer to as Canadian) curriculum mathematics till grade X and suddenly in Grade XI onwards we are studying Indian mathematics, so we find it difficult to cope in grade XI. The concepts such as integration and differentiation are not dealt in grade X and we find it difficult to cope with when we are introduced to integration and differentiation only in grade XI and XII. Similarly the content of trigonometry is less in grade X but it is vast in grade XI. We prefer Indian text books over Canadian textbooks*".

Similar views were expressed by some parents that "*there is a lack of progression in grade X and higher secondary mathematics. This difference is attributed to the school's practice of following two sets of curriculum - Bhutanese curriculum in grade IX & X and Indian syllabus in grade XI and XII*".

Some of the teachers teaching grade XI and XII mathematics expressed their concerns regarding the coverage of syllabus on time owing to its vastness. They confessed that quality of teaching and learning has to be compromised while rushing to cover the syllabus. "*It is difficult to finish the syllabus on time. I take extra classes to complete the syllabus. The content is vast. The vast syllabus affects our teaching. Quite often, we have to rush without considering the learners understanding*".

Lack of secondary mathematics reference books in the library hinders students' performance in mathematics as expressed by some students during interview. For instance, Student 6 expressed, "*The only reference we have in the school is textbook. In the textbook, some concepts are vague and not properly explained but reference books will have alternative ways of explaining things and help us to understand a particular concept better. It would be helpful if the school libraries are stocked with reference books for mathematics*".

The quantitative data revealed that both the students and teachers view remains neutral on the accessibility of mathematics resources in their schools implying that there are no mathematics resources in the schools as reflected in (Table 7).

Two key issues were found related to curriculum aspects in this study. One issue is related to lack of progression in mathematics contents and the other issue is vastness of syllabus. Both issues tended to indicate its impacts in the students' performance at the higher grades. For example, the fundamental knowledge of required mathematical contents in Middle Secondary Schools is the key factor which determines high performance of the students at the higher grades.

In views of the above students' and parents' data in the result section, the present study confirmed that students experience difficulties and challenges while making transition from Middle Secondary to Higher Secondary mathematics, which is a concern over the lack of students' knowledge and foundational mathematical problem solving skills. Therefore, the finding of this study in respect to school mathematics curricula is considered as one of the potential factors that have an adverse effect in teaching and learning of mathematics in both middle and secondary schools. This difference is mainly attributed to the schools' practice of following two sets of curriculum - Bhutanese curriculum in grade IX & X and Indian syllabus in grade XI and XII as agreed by the majority of parents.

Table 7. Teachers' level of opinion on Mathematics resources in the school

SN	Items	N	Mean	SD	Level of opinion
1	The school library has mathematics reference books for students.	6	3.00	1.26	Neutral
2	My school has mathematics resources	6	2.80	0.63	Neutral
	Mean		**2.90**	**0.94**	**Neutral**

3.6. Gender issues

In Bhutanese schools, same learning platform is provided for both boys and girls in all aspects of education system. They also have an equal opportunity to gain admission to colleges and seek careers, based on their academic performance. Despite these initiatives gender differences do appear at schools.

In this study, gender difference in terms of their academic performance is associated with the boys and girls experiences in mathematics and mathematics related activities. Majority of the respondents claim that boys outperform girls in both in mathematics exam and mathematics related activities. For instance, a female student expressed, "*Boys are better in mathematics. I do not know why boys are better. During class time boys participate more than girls. Normally we (girls) do not ask question much during the class time*".

Girls also shy away from mathematics due to low self-esteem as voiced, "*Girls have low self-esteem and lack confidence to interact with teachers and participate in the mathematics learning.*"

Further, one of the participating teachers articulates that girls drop mathematics due to peer influence. He shares an anecdote from his school where once one grade XI girl dropped mathematics as they are allowed but gradually four girls also dropped mathematics.

By the same token school principals too opine that boys are doing better in mathematics as they progressed to higher grades though they perform equally good in mathematics in lower grades, "*In lower grades boys and girls seem to be doing equally good but in higher class boys score better marks than girls. Less girls qualify for science after grade X as I was told that it is scientifically proven that girls thinking power declines as they mature*".

The quantitative analysis of mathematics scores for male and female students based on Middle Secondary School (MSS) and Higher Secondary School (HSS) show that scores of girls fall mostly in the mark range of 31 to 60, whereas mark range for boys fall between 46 to 90 (table 8). Therefore, boys are found to be performing better in mathematics than girls thus confirming the qualitative findings.

Gender difference in mathematics performance was observed in this study. For example, data suggested that male students outperformed female students in mathematics at both middle secondary schools and higher secondary schools in contrast with several previous studies

Table 8 Gender-wise Performance in Mathematics. Note: MSS = Middle Secondary School; HSS = Higher Secondary School

Marks Range	MSS (grade X)		HSS (grade XII)		Total
	Male	Female	Male	Female	
16 – 30	2	7	2	5	16
31 – 45	7	12	9	16	44
46 – 60	9	13	17	15	54
61 – 75	21	6	13	6	46
76 – 90	13	5	9	4	31
91 – 100	4	1	4	0	9
Total	**56**	**44**	**54**	**46**	**200**

reported female students perform better than male students [20]. However, Ajai & Imoko (2015) reported that literature on gender and academic performance in mathematics exists with different views and findings, which varies from regions to regions [10]. In this study, the gender difference in mathematics performance was mainly attributed to girls' lack of interest, low self-esteem or inferiority in mathematics subject, and their choice for arts and humanities subjects at the higher education levels where these subjects are claimed to be less challenging, indicating that girls have higher levels of mathematics anxiety and lower levels of self-confidence in the mathematics solving skills as they make transition into higher grades.

Other potential factors that tended to influence the gender wise performance in mathematics are associated with girls' preference for arts and humanities subjects at the higher grades due to lack of role model holding key position in the current technical work force. This finding is evident from a clear cut gender differences shown in mathematics performance between boys and girls in both middle and higher secondary level schools in this study. This finding is consistent with that of the study conducted by Asante (2010) that indicated a significant gender difference in mathematics performance where boys performing better than girls in Ghana [21].

3.7. Parental support

The study reveals that support and guidance from parents include helping their children with the past question papers, guiding with homework and arranging private tuitions for their children.

One of the participating parents said, "*I helped my child by getting past question papers from other schools and solving them.*" Similarly, other parent expressed, "*I advised my daughter not to roam here and there unnecessarily. I also told her I am not going to ask you do any manual work at home, but your duty is only to study. I never allowed her to go for outing unnecessarily*."

Even if the parents are not able to help their children with homework but constant guidance and available resources help them to perform better in mathematics. For instance respondent student expressed, "*Though my parents are uneducated and do farming but they support us. Somehow my parents heard from somebody that your children will have better opportunities in life if they take mathematics so they encouraged me to take up mathematics. Their constant advice motivated me to take up mathematics and I am very much interested in mathematics*".

The present study indicated that students with good guidance and supports from their parents tended to perform better in mathematics than those students who do not get proper guidance and supports from their parents. This gap in this finding is mainly attributed to students receiving proper guidance and supports from their parents, parents helping their child in solving mathematical skills and techniques, extra support in the form of tuitions, word of encouragement and reinforcement for future job oriented careers etc. So, lack of good parents' supports tended to indicate as one of the contributing factors that influenced the

performance of students in mathematics in this study. Studies have indicated the best predictor of student success in academic life is how well parents or families encourage learning at home and involve themselves in their children' education [22].

Parents' expectation from their kids is always high but parents do play an important role in children education. In this study, it is observed that student achievement is associated with the educational attainment of parents. The student whose parents had higher levels of education out-performed their peers in mathematics than those whose parents had lower levels of education [23]. Similarly, Saritas and Akdemir (2009) also posit that parents' educational level has been shown to be the impeding factor in students' academic achievement [3]. In such case, the extent to which parents or other family members are actively engaged in a student's education had a positive influence on the student's achievement as these parents can create a home environment that can positively influence the child's learning and achievement [4]. In some studies it is also revealed that the parents' income is positively correlated with students' achievement in mathematics [24]. A study in Canada by the Program for International Student Assessment found socio-economic status of parents as one important predictor of discrepancy in academic achievement of Canadian students (aged 15) in mathematics and sciences [25]. Other studies indicate that parents from the higher socio-economic group are more engaged in their children's education, and such involvements resulted in developing positive attitudes of their children toward academic achievement [26]. On the other hand, the parents from low socio-economic group negatively influence academic achievement, in part, because students have no access to educational materials and resources at home [7]. For these reasons, socio-economic status of a student is an important factor that determines academic achievement.

4. CONCLUSION AND RECOMMENDATIONS

This study provided a wide range of impeding factors that influence the poor performance of students in mathematics subject in the Bhutanese secondary education system. Analyses from this study revealed several important factors attributing to students' poor performance in the mathematics subject that pose greater risk of prolonging the present declining trend of quality in mathematics education if necessary interventions and innovative tools are not put in place. Therefore, the present study posits the collaboration as a rich and powerful learning space, where involvement of government policy makers, ministry of education as implementers, academic, teacher educators, and various other relevant educational stakeholders come together with different expertise that are conducive to the development of teachers and students for the 21st century education system. Innovative policy plans and interventions are needed with enabling tools and strategies to address these issues and challenges.

It is therefore, recommended that one effective way of bridging this gap is building a strong partnerships among relevant educational stakeholders (e.g. government policy makers, ministry of education, national curricula

developers, initial teacher preparation institutions, schools and mathematics teachers) to view effective education in the country as collective responsibility and effort towards the realization of larger educational goals and aspirations of producing nationally rooted and globally competent mathematics students. Because coexistence of healthy relationships between the educational institutions and policy implementation has an inherent value beyond benefitting measurable outcomes, where democratic values, engagement and learning for the future profession are promoted, thereby playing a pivotal role in shaping the skills and knowledge required by today's education system.

It is also recommended that school mathematics teachers should improve the mathematics teaching with due diligence to desirable students' achievement in the subject, and use innovative teaching, learning and assessment practices and available resources to improve the students' achievement in mathematics.

Gender difference in mathematics performance was also observed, and was mainly attributed to girls' preference for arts and humanities subjects at the higher grades due to lack of role model holding key position in the current technical work force. It is envisage that increasing the female mathematics teachers in the school may help in narrowing gaps between gender differences and performance in mathematics.

5. CONFLICT OF INTEREST

NA

6. ACKNOWLEDGMENT

We would like to thank the Royal University of Bhutan for the financial support of this research project. In addition, the authors acknowledge the supports of college management, research participants (students and mathematics teachers), school principals, and parents for their cooperation.

7. SOURCE/S OF FUNDING

This research project was funded from the Annual University Research Grant (AURG) of (2018-2019) by the Royal University of Bhutan.

8. REFERENCES

1. Tobgay, S. (2014). Education system in bhutan–past, present and future a reflection.
2. Convocation address, Royal Thimphu College, February 2018 retrived from: https://www.rtc.bt/index.php/more-news/218-graduation-night
3. Saritas, T., & Akdemir, O. (2009). Identifying factors affecting the mathematics achievement of students for better instructional design. International Journal of Instructional Technology and Distance Learning, **6(*12*)**, 21-36.
4. Arslan, H., Canli, M., & Sabo, H. M. (2012). A Research of the Effect of Attitude, Achievement, and Gender on Mathematic Education. Acta Didactica Napocensia, **5(*1*)**, 45-52.
5. Pianta, R. C., Belsky, J., Vandergrift, N., Houts, R., & Morrison, F. J. (2008). Classroom effects on children's

achievement trajectories in elementary school. American Educational Research Journal, **45(*2*)**, 365-397.

6. Abdullah, M., Abd Majid, R., Bais, B., Bahri, N. S., & Mokhtar, M. H. (2018). Space Weather Monitoring System Competition for Secondary School Students in Malaysia. In Space Science and Communication for Sustainability (pp. 135-146). Springer, Singapore.
7. Mbugua, Z. K., Kibet, K., Muthaa, G. M., & Nkonke, G. R. (2012). Factors contributing to students' poor performance in mathematics at Kenya certificate of secondary education in Kenya: A case of Baringo County, Kenya. American International Journal of Contemporary Research, **2(*6*)**, 87-91.
8. Sidhu, G., & Srinivasan, S. (2018). An intervention-based active-learning strategy to enhance student performance in mathematics. International Journal of Pedagogy and Teacher Education, **2(*1*)**, 85-96.
9. Delaney, Y., McCarthy, J., & Beecham, S. (2017, June). Convergent parallel design mixed methods case study in problem-based learning. In ECRM 2017 16th European Conference on Research Methods in Business and Management (p. 408). Academic Conferences and publishing limited.
10. Ajai, J. T., & Imoko, B. I. (2015). Gender Differences in Mathematics Achievement and Retention Scores: A Case of Problem-Based Learning Method. International Journal of research in Education and Science, **1(*1*)**, 45-50.
11. Kiptum, J. K., Rono, P. K., Too, J. K., Bii, B. K., & Too, J. (2013). Effects of students gender on mathematics performance in primary schools in Keiyo South District, Kenya. International Journal of Scientific & Technology Research, **2(*6*)**, 247-253.
12. Mutodi, P., & Ngirande, H. (2014). Exploring Students' Ability to Read Mathematics Text: Case Study of Selected Secondary Schools in the Limpopo Province. International Journal of Educational Sciences, **6(*3*)**, 383-394.
13. Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. Econometrica, **73(*2*)**, 417-458.
14. McMillan, J. H. (Ed.). (2013). SAGE handbook of research on classroom assessment. Sage.
15. Setapa, M., Mustaphal, W. A. H. W., Kanafiah, S. F. H. M., & Zaman, L. K. (2016). A study of students' perception toward mathematic. Journal of Applied Environmental and Biological Sciences, **6(*7*)**, 28-33.
16. Olaleye, F. O. (2011). Teacher characteristics as predictor of academic performance of students in secondary schools in Osun State–Nigeria. European journal of educational studies, **3(*3*)**, 505-511.
17. Grossman, P., & McDonald, M. (2008). Back to the future: Directions for research in teaching and teacher education. American Educational Research Journal, **45(*1*)**, 184-205.
18. Umameh, M. A. (2011). A survey of factors responsible for students' poor performance

in mathematics in senior secondary school certificate examination in Idah local government area of Kogi state, Nigeria. Unpublished M. Ed Thesis, University of Benin, Benin City.

19. Broussard, S. C., & Garrison, M. B. (2004). The relationship between classroom motivation and academic achievement in elementary-school-aged children. Family and Consumer Sciences Research Journal, **33(*2*)**, 106-120.
20. Alkhateeb, H. M. (2001). Gender differences in mathematics achievement among high school students in the United Arab Emirates, 1991–2000. School Science and Mathematics, **101(*1*)**, 5-9.
21. Asante, K. O. (2010). Sex differences in mathematics performance among senior high students in Ghana. Gender and Behaviour, **8(*2*)**, 3279-3289.
22. Wright, K. B., Shields, S. M., Black, K., & Waxman, H. C. (2018). The Effects of Teacher Home Visits on Student Behavior, Student Academic Achievement, and Parent Involvement. School community journal, **28(*1*)**, 67-90.
23. Quimbo, S. L. A. (2003). Explaining math and science achievement of public school children in the Philippines. Philippine Review of Economics, **40(*2*)**, 59-72.
24. Eamon, M. K. (2005). Social-demographic, school, neighborhood, and parenting influences on the academic achievement of Latino young adolescents. Journal of youth and adolescence, **34(*2*)**, 163-174.
25. Council of Ministers of Education (Canada), Statistics Canada, Canada. Human Resources Development Canada, & Bussière, P. (2001). Measuring up: The performance of Canada's youth in reading, mathematics and science: OECD PISA study: First results for Canadians aged 15. Statistics Canada.
26. Shaban, O. (2015). The relationship between mathematics grades and the academic performance of accounting students' department. The European Proceedings of the Social & Behavioral Sciences, **4(*4*)**, 35-41.