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Students' Mathematices Related Beliefs at Secondary Level: Sector-Wise Comparison

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***Abstract*:** This study focused investigating the relationship between students of secondary school in regard to their beliefs about the subject of mathematics and their approach to mathematical non-routine problem solving. Their belief system was investigated sector-wise by utilizing the retrospective questionnaire and the data were collected from 400 students of District Buner. SPSS version 17 was used to analyze the date by applying t-test, ANOVA and inferential statistics. Their mathematics-related beliefs were classified into three categories, according to Daskalogianni and Simpson's (2001) macro-belief systems, utilitarian, systematic and exploratory. General behavior of the learners' problem solving strategies that reflected their general behavior in non-routine mathematical problem solving were identified, that include in systematic guess, check and revise; systematic guess, check and revise; trial-and-error; systematic listing; looking for a pattern; making a model; and considering a simple case. A weak positive linear relationship between learners' mathematics-related belief systems and their approaches to non-routine problem solving was discovered.

Keywords: Mathematics-related belief system, Problem solving, Non-routine problem solving

1. Introduction

Four categories are made by (MCLEOD 1992) of students beliefs which are 1. Beliefs regarding mathematics 2. Beliefs regarding the context in which the math education transpires. 3. Beliefs regarding self. 4. Beliefs about math teaching. So this structure of math related beliefs were adopted and suggested by many researchers in the past.(HANNULA et.al2005)In another study (Decort and Eynde 2003) mentioned that the cognitive action of the students are affected with both conscious and unconscious held beliefs about the given assignment of .(mathematics) ,in which the social task is also existing (context) and the students self-perception about the task (self)

This system may be divided into multiple categories as, how beliefs work together to effect behavior and thoughts. (Schoenfeld 1985 as cited by Op, Eynde 2004) finds that mathematical beliefs system is as one's own mathematical world view the perception in which one approach mathematical tasks. Secondly, he mentioned that the belief of someone about math can decide how one select and approach to a certain problem, what procedures to be adopted

how much time will be needed. Context is created by the beliefs with in which means and control work. (page.2). General beliefs of students are knowledge, learning and in some cases knowing. First of all, the construction of belief systems is intuitive. There are some beliefs which are basic and some of them are disposable. Like, a learner thinks as math is valuable for their lives (this is a fundamental belief). So he considers it very necessary to (1) for hard work during the lessons in the class of math and (2) try to solve problems and try to practice exercises in everyday life. (This is moral beliefs).

Second, Green (1971) talks about the mainstream of central belief system. The main beliefs are very significant that hold firmly, while the scenarios could be changed very easily. In the opinions of the scholars, with experience, perform and certification, the beliefs of people could become important. For example, the school instructor has further approval, which is more transformative and capable. Experienced instructors have a very deep experiences and beliefs. It has been noticed by the researchers about this decision – "I have been teaching for 20 years, and I know precisely which method is effective" – on many occasions in the process of teaching learning of math. In some of the occasions, beliefs could be extremely expedient for growth. The concepts of teachers regarding "good mathematics teaching" have been passed in roots which differ in superficial changes (changes in acceptable beliefs) – as text, and the teaching audio video aids and the management of classroom on the students cannot affect (Pehkonen, 1999, p. 7). It is to be noted that there is no need to reduce the value of experience, rather of emphasize the significance of others' elasticity and clear mindset.

(De Corte 2006) described that the epistemological belief are the definite domain and describe the particular set of mathematical related beliefs.

1.2 Objectives of this Study

a) To investigate students' mathematics related beliefs in the context contents of mathematics
b) To investigate students' mathematics related beliefs in context of teachers instruction
c) To compare students' mathematics related beliefs private/public sector wise
d) To identify interaction effect between sector-wise in mathematics related beliefs

1.3 Research Questions

a) What are students' mathematics related beliefs in context of contents of mathematics?
b) What are students' mathematics related beliefs in context of teacher's instruction?
c) What is the comparison of students' mathematics related beliefs private/public sector wise?
d) What is the interaction effect between sector-wise in mathematics related beliefs?

2. Literature Review

Beliefs in mathematics believe that math is basically math or maximum mathematical troubles could be calculated just in few moments. In the work of Schoenfeld (1989), "Explorations of Students' Mathematical Beliefs and Behaviour", He found some views of the students that they think about the subject of math, that it is very tough and sticking to the complicated rules that require hygiene and many exercises. He also discovered that student are of the opinion in a common home task problem should take approximately two minutes for solving and if they are doing work for more than ten minutes, they think this problem was impossible hard to solve. In 1989, Schoenfeld states that distressing characteristic of his research regarded by many professors' beliefs did not actually exist behaviours. Schoenfeld (1989) proposes that in his research, students have "come to separate school mathematics – the mathematics they know and experience in their classrooms – from abstract mathematics, the discipline of creativity, problem solving, and discovery, about which they are told but which they have not experienced" (p. 349). It has been discovered that students regard the subject of math a very boring and complicated. On the contrary, researcher agree that students' beliefs are related to the math which direct them in the atmosphere of classroom behaviour could have a very significant force on non-routine mathematical problem solving problems (McLeod, 1992).

Research the concept of self esteem and the properties associated with it math spends to concentrate on the beliefs regarding self (McLeod, 1992). Malmivouri's (2004) a moving approach to impact emphasizes personal compliance and the role of organizational aspects of self-responsiveness affecting the social, diverse and circumstances in the environment. She tells that students' thoughts are particularly significant, impressive, and charming expeditions. It has been told by her that those are the very effective things which affect it and are linked to the experiences of autonomous, self-esteemed and /or personal control with mathematical respect. The function of self – belief in mathematical teaching is very lucid by Schoenfeld (1989) while he explained so as to his study

has presented a constant link flanked by the middle trust with success.

2.1 Belief Systems

Various sorts of beliefs are present in various parts of questionnaire. On the beliefs system, this confession is based on it. In 1971, Green indicates that personal beliefs are related to the logic, where logic is individually described. Regarding about the topic of math, the individual beliefs system about math is called his mathematical approach (Pehkonen, 1999; Schoenfeld, 1985). Man's system of beliefs is vibrant, transformer when people assess and evaluate their events and beliefs then they are constantly reorganizing their system (Thompson, 1992). According to interpretations, in 1971, Green identified three scopes of the beliefs system where they emphasize the relationship amid the beliefs system. First of all, the construction of belief systems is intuitive. There are some beliefs which are basic and some of them are disposable. Like, a learner thinks as math is valuable for their lives (this is a fundamental belief). So he considers it very necessary to (1) for hard work during the lessons in the class of math and (2) try to solve problems and try to practice exercises in everyday life. (This is moral beliefs).

Second, Green (1971) talks about the mainstream of central belief system. The main beliefs are very significant that hold firmly, while the scenarios could be changed very easily. In the opinions of the scholars, with experience, perform and certification, the beliefs of people could become important. For example, the school instructor has further approval, which is more transformative and capable. Experienced instructors have a very deep experiences and beliefs. It has been noticed by the researchers about this decision – "I have been teaching for 20 years, and I know precisely which method is effective" – on many occasions in the process of teaching learning of math. In some of the occasions, beliefs could be extremely expedient for growth. The concepts of teachers regarding "good mathematics teaching" have been passed in roots which differ in superficial changes (changes in acceptable beliefs) – as text, and the teaching audio video aids and the management of classroom on the students cannot affect (Pehkonen, 1999, p. 7). It is to be noted that there is no need to reduce the value of experience, rather of emphasize the significance of others' elasticity and clear mindset.

Third, in 1971, Green employs the term "cluster" which means the clauses of beliefs. Clauses are interconnected with one another but are not free from one another. (Pehkonen, 1999). This hypothesis may tell in detail about the disagreement of teachers' beliefs. There are many ways to categorize the beliefs of math. There are different methods of different researchers (Op't Eynde, de Corte & Verschaffel, 2002), instead there are widespread beliefs about four groups of math.

- The beliefs regarding nature of math,
- The beliefs of knowing and getting knowledge regarding math.
- In the background of mathematical education and instructing beliefs about themselves,

2.2 Mathematical Related Belief System

A lot of researchers have narrated various sorts of definitions about mathematics related belief systems (e.g. Benbow, 2004' Cellejo& Vila, 2009; Op'tEynde, De Corte, & Verschaffel, 2006; Schoenfeld, 1985). Some scholars present the definition of belief system in means of the elements (e.g.Op'tEynde et al., 2006; Schoenfeld, 1985); whereas some other scholars give this definition that it is a pathway where we can found organized sorts of beliefs (e.g. Benbow, 2004; Callejo & Villa, 2009). The scholars have viewed in this research about math connected systems of belief as thought by Schoenfeld (1985) and Op'tEynde et al. (2006).

According to some of the scholars like, Daskalogianni and Simpson (2001), Jin, Feng, Liu, and Dai (2010), Lazim, Abu Osman, and Wan Salihin (2003), Op'tEynde et al. (2006), and Schoenfeld (1992), presented various sorts of groups regarding mathematics-related beliefs systems. These scholars discovered shortage of harmony amongst these researchers about the exact groups of beliefs system in the subject of mathematics. All these researchers have their own point of views about the groups of mathematics related beliefs system. Those students who classified in the category of "systematic" consider so that math is not dynamic subject which is comprised of a strict code of rules and regulations. They feel very relaxation because they put into practice their past activities or methodologies. So as to, they also consider the subject of math as appealing to the mind, and also consider the past exercises of mathematics as activities which have precise replies and that is included of many sequenced steps. When these students are solving the problems, so they are much dependent upon their instructors and consult their past sources of notes.

Those students who are categorized in the group of "exploratory" think about the subject of mathematics as "dynamic". It is regarded by them that new discovered phenomenon, views and methodologies are very helpful to

them in the field of solving the problem. It is viewed by them that the subject of mathematics is necessary to be involved in the process of solving the problem, in addition of containing a lot of exact solutions.

2.3 Clusters and Correlations

It is clear that the variety of the learners which can fit the structure of Op'tEynde and DeCorte's (2003) to be enormous. In 2005, Hannula and others explain that this very enormous sort of structure of beliefs related to the subject of mathematics is often clustered in groups which influence everyone in the system of beliefs of the learners. This had been a subject of research for many years about the connection of beliefs of the students (Fennema, 1989; Schoenfeld, 1989; Hembree, 1990; Op'tEynde & De Corte, 2003; Hannula et al. 2005). In 1989, Schoenfeld explored in his study that the performance in academic qualification of the students in overall, athletic performance of the students as well as the sense of their abilities in athlete is linked. Schoenfeld mainly considers the links in the self-beliefs of the students. The powerful relationship had been was predicted as athletic presentation and supposed athletic capability. This discovery shows that despite the goals of students or individual beliefs regarding the nature of aptitude, Dweck (1986) is described; someone expected to believe in his own mathematical ability. That would do a good job. Without strong confidence in anyone's capacity, the aim of the performance is the purpose of a student who believes intelligence will be to engage in the tasks and will expect poor performance. Students based on learning objectives may engage in the challenge of whether they believe in their mathematical ability. This kind of student would believe that if they believe in their capability in mathematics. In 1992, McLeod describes in detail with the intention of "It seems likely that success in problem solving will engender a belief in one's capacity for doing mathematical problems, leading to an increase in confidence, which correlates positively with achievement in mathematics" (McLeod, p. 584).

That was initiated by Shoenfeld (1989) as well that, "students who think less of their mathematical ability tend more to attribute their mathematical success to luck and their failures to lack of ability whereas those who think themselves good at mathematics attribute their success to their abilities" (p. 347). Lastly, they revealed self-esteem and contact between one believe in objection: "those who see themselves as Mbeing good at mathematics also tend to find the subject interesting" (p. 348).

Op't Eynde and De Corte (2003, 2004) even discovered the main contact between mathematical beliefs. Such mutual contact was that students with more mathematical viewpoint view students as valuable as mathematics furthermore have extra confidence in their mathematical capability. Moreover, they have got extra positive beliefs regarding teacher's work. In this evaluation, we notice the contact between the three elements of their ideological structure for mathematical belief systems. Within this beliefs system, it is separated by them the two beliefs about math (the object). An element learner assumed that the subject of math is a public matter, otherwise not, as well as a good domain of math student's view from the other element. Op'tEynde and De Corte declared that these two features although connected with other features, were connected to each other only. Amazingly, there was an element of mathematical social-building approach, and the absolute theory was present in another element of mathematical learning and problem solving. In relation to each other negatively, both of these ideological concepts will not have positive affair. Op'tEynde and De Corte (2003) anticipated so as to "the orientation toward achievement and grading, that up to a certain point always characterizes a mathematical school context, might account for the presence and acceptance of certain absolutist characteristics" (p. 9). The beliefs of self were connected to one another with the beliefs of object. For instance, the learners who have confidence in them are convinced of the mathematical compatibility. In their (2005) study, Hannula et al. contact close to their eight aspects. After evaluation, he proved that within many contacts between ten aspects, three aspects were closely linked and those who created the "core" label of the mathematical person's view. The three basic elements making the basic location of beliefs were: (F1) "I am not talented in mathematics" – a self-belief, (F7) " I like mathematics" – exhibiting an emotional link to the thing, and (F8) " Mathematics is difficult" – an object beliefs. Aspect 1 and 8 were linked as negative

to aspect 7. Five other aspects located around the fundamental beliefs s were mainly related the cover with some secondary relations only. Beliefs which played a key role in basic beliefs: (F6) "I can do well in mathematics" (positive relation) and (F4) "I had a poor teacher in mathematics" (negative relation). Other aspects that had only a slight effect on the basic aspects were 2, 3 and 5. They integrated the beliefs relating their personal workload, the support and capabilities of their family as like math. After thinking about the strong connection between the basic beliefs of the students in their study, Hannulla et al. (2005) declared so as to: "a person with a positive view believes oneself to be talented in mathematics, believes mathematics to be easy, and likes mathematics. The person

with a positive view is usually also confident on being able to do well in mathematics, hard-working, and satisfied with the teaching he or she had in mathematics" (p. 97).

The concept of the presence of the basic set of mathematical beliefs is worth some attention in mathematical education research. Pietila (as cited by Hannula, 2005) says it's just the experiences that can fundamentally change the mathematical student's perspective. It shows that if mathematics researchers want to promote mathematical positive views, they can succeed; they must pay attention to the students' basic beliefs before anyone else. In order to start this procedure, the instructors should have the way to exactly assess the learners' beliefs.

3. Research Design

The study was conducted in the public and private male and female secondary schools of District Bunir, KPK selected voluntarily. Four hundred students were randomly selected from all of the male and female selected schools' for this study. One hundred and thirty (130) students were selected from Public boy's schools and one hundred (100) students Public Girls schools. Similarly, one hundred and twenty (120) students were taken as sample from Private boy's schools and fifty (50) from girls Private schools. A closed ended questionnaire Related Beliefs Questionnaire (MRBQ) was developed for data collection which was consist of 20 questions. The first five questions were based on significance; the next five on competence, the other five on teacher role and the last five were about the contents.

3.1 Population of the Study

Population of this study consist of all the Public and Private boys and girls secondary schools of KPK, and was delimited to five boys and girls Public and Private schools of District Bunir.

Table 1: Population Details

Sector	Female	Male	Total
Public	2500	8152	10652
Private	482	4401	4883
Grand Total			**15535**

3.2 Sampling

Simple random sampling was used for this study. For data collection 400 students were selected randomly from GHSS Amnawar, GHS Gagra, GGHSS Kalpani, Oriental Public School Deewana Baba and Iqra Public School district Buner.

Table 2: Sample

Sector	Male	Female	Total
Public	130	100	230
Private	120	50	1 70
Grand Total		**400**	

These schools were selected for this study with volunteer sampling. Principals of the selected schools were requested for volunteer cooperation. Questionnaires were distributed among the selected students. To select the students for this study, simple random sampling was used.

4. Data Analysis and Interpretation

4.1 Sector Wise Comparison of Students Mathematics Related Beliefs in the Sub Scales

Table 3: Sectors Wise Comparison

	Sector	N	Mean	Std. Deviation
Significance	Public	211	9.483	2.3550
total	Private	189	9.624	2.6461
Competence	Public	211	8.900	2.5213
total	Private	189	8.381	2.6079
Teacher role	Public	211	7.664	2.4330

total	Private	189	6.931	2.4300
Contents	Public	211	9.981	2.9211
total	Private	189	8.857	3.2100
total	Public	211	36.028	7.3465
	Private	189	33.794	8.3344

The above table shows that the mean value of sub construct of mathematical beliefs i.e. significance, competence, teacher role and contents that public students have relatively better mean score than private students in the sub construct of students role and contents. While in the sub category of significance and competence private students show a bit more mean value than public students. Standard deviation of private students show that private students had a little bit more variety in the sub constructs of significance competence and contents. While in the category of teacher role both sectors i.e. public and private show the same results. The total score of mean for all categories show that public sector has great mean value than private sectors while the score of total standard deviation show that private sector has a bit more variety in their responses and views.

4.2 Independent Samples Test

Table 1: Independent Samples

Variables	Sig.	t	difference
Significance total	.579	-.564	378.73
Competence total	.374	2.024	389.90
Teacher role total	.608	3.007	393.31
Contents total	.517	3.666	382.12
total	.512	2.850	377.18

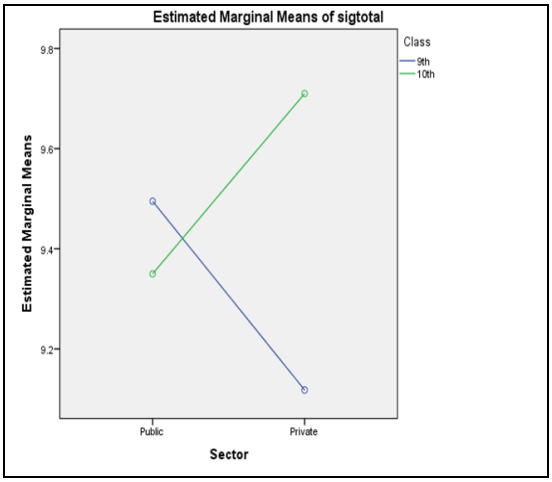
The above table shows that significance value of teacher role is the greatest in all the sub categories i.e. 0.608 showing that the teachers have an enormous and key role in constructing the beliefs of their students about mathematics. The T-test shows that the value of contents is more than all the constructs.

4.3 Interaction Analysis

The impact of sector and class was found. Four aspects of Mathematical beliefs were introduced into the ANOVAs.

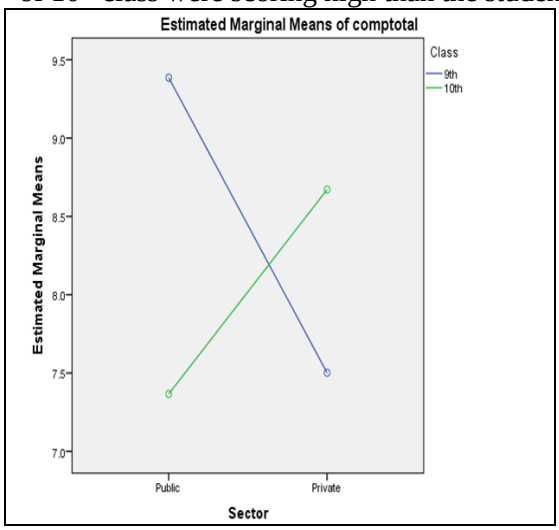
4.4 Interaction Graphs of Sector and Class in the Field of Significance

The potential gender-sector interaction was found in the graph below. The figure shows that the score of both male belonging to public and private school students in the level of Significance were almost same because they are joining on the same point. While the score of female students belonging to public sector was greater than female students belonging to private sector. While comparing the students of male and female of 9^{th} and 10^{th}class, the score of male students of 10^{th} class were scoring a bit more than the male students of class 9^{th}. Whereas, female students of 10^{th} class were scoring very high than female students of 9^{th}class. Now comparing the students of 9^{th} and 10^{th} class belonging to public and private sectors we got that there is a cross intersection in the students of 9^{th} class scored greater than the students of 10^{th} class in the public sector. While the students of 10^{th}class were scoring very high than the students of 9^{th} class in private sector.



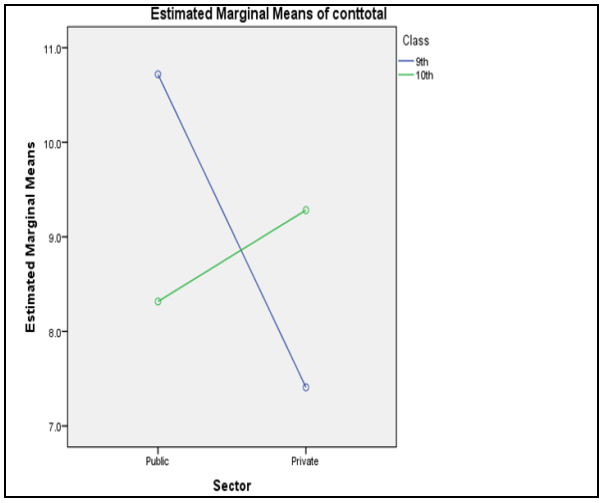
4.5 Interaction Graphs of Sector and Class in the Field of Competence

The potential interaction between gender, sector and class in the level of competence has been investigated with the help of the graph of the interaction below. There is a cross intersection between gender and sector in this graph. It has been shown in figure below that the male students of private sector scoring better than the male students of public sector. While female students of belonging to public were scoring very high than the female students of private sector. We saw a big difference between male students of 9^{th} and 10^{th} class. The male students of 9^{th} class were scoring better than male students of 10^{th} class while female students of 9^{th} class were also scoring high than the female students of 10^{th} class. Once again there is cross intersection in this very graph. It has been also shown that the students of 9^{th} class were scoring better than the students of 10^{th} class in the public sector while the students of 10^{th} class were scoring high than the students of 9^{th} class in private sector.



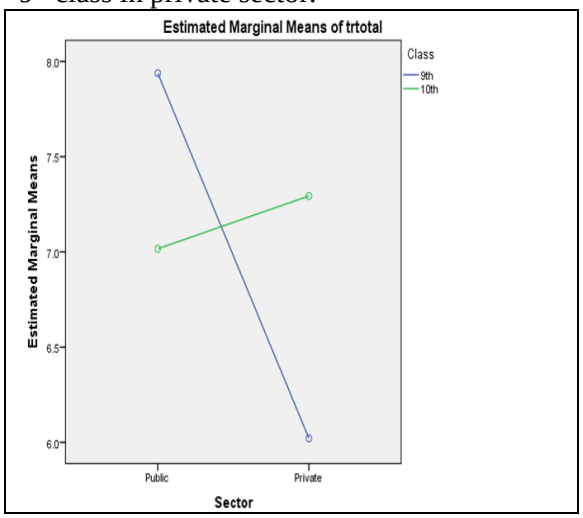
4.6 Interaction Graphs of Sector and Class in the Field of Contents

The possible interaction between gender and sector and class in the level of contents has been shown in the graph below. There is no cross interaction in this graph regarding contents. The figure shows that the male students belonging to public sector scoring better than the male students of private sector. Same is the case with the female students here; the female students of public sector were scoring high than the female students of the private sector in the field of contents. Now there is a cross interaction in the graph of gender and class. The male students of 9^{th} class scoring better than the male students of 10^{th} class. Once again there is a cross intersection between sector and class. We found that the students of 9^{th} class were scoring better than the students of 10^{th} class in public sector. Here the case is reversal; the students of 10^{th} class belonging to private were scoring better than the students of 10^{th} class in private sector.



4.7 Interaction Graphs of Sector and Class in the Field of Teacher's Role

The potential interaction between gender, sector and class has been investigated with the help of the graph of the interaction below. There is no intersection in the graph between gender and sector in the level of role of teacher. We found that the male students belonging to public sector were scoring better than the male students of private sector. Same is the case with the female students in these sectors, that female students of public were also scoring high than the female students of private sector in the level of teachers' role. The male students of 10^{th} class were scoring slightly better than the male students of 9^{th} class, while the female students of 10^{th} class were showing very high score than the female students of 9^{th} class. There is a cross intersection in this graph of sector and class. The students of 9^{th} class were scoring better than the students of 10^{th} class in the public sector. While the case is reverse with female students of private sector, because female students of 10^{th} class were scoring better than the students of 9^{th} class in private sector.



4.8 Findings

Following are the important findings of this study.

a) Four aspects of Students' Mathematics Related Beliefs were identified in this study i.e. Significance, Competence, Teachers' Role, and Contents.
b) Mean score of public sector was 9.483, 8.900, 7.664 and 9.981 as compare to the ;mean score of private sector of 9.624, 8.381, 6.931 and 8.857 respectively for sub scale i.e. Significance, Competence, Teachers' Role and Contents. (Table 4.3)
c) Score of Standard Deviation of public sector was 2.3550, 2.5213, 2.4330 and 2.9211 as compared to the score of private sector was 2.6461, 2.6079, 2.4300 and 3.2100 respectively. (Table 4.3)

d) Significant values for the sub scale i.e. Significance, Competence, Teachers' Role and Contents, was 0.579, 0.374, 0.608 and 0.517 respectively in Sector Wise Comparison of Students' Mathematics Related Beliefs. (Table 4.4)
e) Mean score was 9.452, 9.057, 7.390 and 9.871 for 9th Class as compared to the 10th Class was 9.658, 8.211, 7.237 and 8.984 respectively in the Class Wise Comparison of Students regarding Students' Mathematics Related Beliefs in the sub scale. (Table. 4.4)
f) The value of Significance of sub scales i.e. Significance, Competence, Teachers' Role and Contents was 0.551, 0.879, 0.319 and 0.623 respectively. (Table 4.4)

5.1 Conclusions

a) Four aspects of Students' Mathematics Related Beliefs were identified in this study i.e. Significance, Competence, Teachers' Role and Contents (Finding No.1)
b) The value of Significance of Students is the greatest in the sub scale of Teachers' Role i.e. 0.804 showing that teachers have a great role in building beliefs of students about mathematics. (Finding No.4)
c) The value of mean of Public Students have relatively better mean score than Private Students in most of the sub scales, however this difference of mean is not so much significant in Sector Wise Comparison of Students' Mathematics Related Beliefs (Finding No.5)
d) Larger Standard Deviation in most of the cases of Private Students shows that private students had a little bit more variety in their beliefs than public school students (Finding No.6)

5.2 Recommendations

The most important purpose of this research was to build up mathematical thinking in students. It may be that the students' beliefs about learning mathematics are closely related to the mathematics. Self-impact on teachers' role and items are designed in separate factors. Students' answers have indicated that they agree with the role of authority in the classroom, but their classroom experiences have many beliefs about the associated nature of mathematical knowledge and solutions to mathematical problems. The purpose of this study was to test the factors (personal and teachers' role) affecting the beliefs of students.

Important recommendations can be made based on the study of this research for study holder.

a) In this study, four aspects of students' mathematics related beliefs were identified and verified for the development of instruments. These aspects are recognized for the purpose that special attention should be made to gain more success in building creative beliefs and reduce the concern the level of concern.
b) It is essential for math teachers to bring mathematical classrooms into a positive environment so that students in mathematics can increase their performance in building beliefs in the subject of mathematics.
c) Open queries should be encouraged while enhancing beliefs regarding mathematics.
d) New teaching methodologies should be promoted and put into practice in the class of mathematics.

The suggestions from teachers and experts show that the main reason for facing the problem of lack of ability to enhance the creative beliefs in the subject of math is due to the lack of lack of knowledge in math. Therefore, these suggestions can be considered and they can help, and encourage them to perform these activities.

References

Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist*, 41 (10) 1040-1048.

Fennema, E. (1989), The study of affect and mathematics: A proposed generic model. In D. B. McLeod & V. M. Adams (Eds.). Affect and Mathematical Problem Solving: A New Perspective (pp. 205-219). New York, Springer.

Green, T.F. (1971).The activities of teaching. McGraw-Hill series in Education Foundations in education. New York: McGraw-Hill.

Hannula, M. (2002). Attitude towards mathematics: Emotions, expectations and values. *Educational Studies in Mathematics*, 49, 25-46.

Hannula, M. (2004). Affect in mathematics education – Exploring theoretical frame works. In M. Johnsen Hoines & A. B. Fuglestad (Eds.), Proceedings of the 28th(Vol. 1, pp. 107-109). Bergen: Bergen University College. International Conference for the Psychology of Mathematics Education

Hannula, M., Kaasila, R., Laine, A. &Pehkonen, E. (2005). Structure and typical profiles of elementary teacher students' view of mathematics. In Chick, H. L. & Vincent, J. L. (Eds.), Proceedings of the 29th Group for the Psychology of Mathemaics Education, (Vol. 3, pp. 89-96). Conference of the International Melbourne: PME.

Hembre, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in Mathematics Education*, 21(1), 33-46.

Leder, G. C. &Forgasz, H. J. (2006). Affect and mathematics education. In Gutierrez, A. & Boero, P (Eds.), Handbook of Research on the Psychology of Mathematics Education: Past, Present and Future, 403-427.

Mandler, G. (1989). Affect and learning: Causes and consequences of emotional interactions. In D. B. McLeod & V. M. Adams (Eds.), Affect and mathematical problem solving: A new perspective (pp. 3-19). New York: Springer-Verlag.

Malmivouri, M. J. (2004). A dynamic viewpoint: Affect in the functioning of self-system processes. In M. Johnesen Hoines & A. B. Fuglestad (Eds.) Proceedings of the 28th (Vol. 1, pp. 114-118). Bergen: Bergen University College.

McLeod, D. B. (1989). The role of affect in mathematical problem solving. In D. B. McLeod &V. M. Adams (Eds.), Affect and mathematical problem solving: A new perspective (pp. 20-36). New York: Springer-Verlag.

McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. In D. A. Grows (Ed.), Handbook for research on mathematics teaching and learning (pp. 575-596). New York: Macmillan.

Nurmi, A., Hannula, M., Maijala, H., & Pehkonen, E. (2007). On pupils' self-confidence in mathematics: gender comparisons. In N.A. Pateman, B.J. Dougherty & J. Zilliox (eds.)Proceedings of the 27th Conference of the International Group for the Psychology of Mathematics Education, 3, 453-460. University of Hawaii.

Op'tEynde, P., de Corte, E. &Verschaffel, L. (2002). Framing Students' Mathematics Related Beliefs . A Quest for Conceptual Clarity and a Comprehensive Categorization. In G. C. Leder, E. Pehkonen, and G. Törner (Eds.), Beliefs: A Hidden Variable in Mathematics Education?(pp. 13-38). Dordrecht: Kluwer Academic Publishers.

Op'tEynde, P. & De Corte, E. (2003). Student's mathematics-related belief systems: Design and analysis of a questionnaire. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, April 21-25, 2003.

Op'tEynde, P. & De Corte, E. (2004). Junior high students' mathematics-related belief systems: Their internal structure and external relations. A paper presented in TSG24 at ICME-10. Available online at http://www.icmeorganisers.dk/tsg24/Documents/OptEyndeDeCorte.doc

Op'tEynde, P., & Hannula, M. (2006). The case study of Frank. *Educational Studies in Mathematics*, 63, 123–129.

Pehkonen, E. (1994). Teachers' and pupils' beliefs in focus – consequence of constructivism. In M. Ahtee, and E. Pehkonen (Eds.), Constructivist Viewpoints for School Teaching and Learning in Mathematics and Science (pp. 27-33). Helsinki: University of Helsinki. Department of Teacher Education. Reseach Report 131.

Pehkonen, E. 1997. Learning results from a viewpoint of equity: boys, girls and, mathematics. *Teaching Mathematics and its Applications* 16 (2), 58-63.

Schoenfeld, A. H. (1985). Mathematical Problem Solving. Orlando: Academic Press.

Schoenfeld, A. H. (1989). Exploration of students' mathematical beliefs and behavior. *Journal for Research in Mathematics Education*, 20 (4), 338-355.

Thompson, A. G. (1992). Teachers' Beliefs and Conceptions: A Synthesis of the Research. In D. A. Grouws, (Ed.), Handbook of Research on Mathematics Teaching and Learning (pp. 127-146). New York: Macmillan.