Bhutanese Eighth Grade Students’ and Teachers’ Perceptions of their Classroom Learning Environment in Relation to the New Mathematics Curriculum

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Classroom learning environment, new mathematics curriculum, perceptions, learning environment, classroom environment, teacher support, student cohesiveness, task orientation, cooperation, equity, personal relevance, critical voice, student negotiation
Abstract

Curriculum reform and change is a continual process in any education system to improve the quality of classroom instruction and motivate students to learn, which ultimately results in improving the overall quality of education in the country. The curriculum is the key element of an education system, while the classroom learning environment has a critical role to play in the efficacy and success of curriculum implementation. Although the field of learning environment is well established and many studies have been conducted in many countries, to date little research exists on the perceptions of classroom learning environments in the Bhutanese school context, where a new standards-based mathematics curriculum was recently introduced.

This mixed-methods study investigated the perceptions of Bhutanese eighth grade students and teachers of their mathematics classrooms within the framework of a social constructivist theory and classroom learning environment literature. The study aimed to assess their perceptions of classroom learning environments which will reflect the possible impact of the new mathematics curriculum on classroom practices. It will also examine the underlying contextual factors that affect the process of learning in mathematics classrooms, and explore possible differences in their perceptions of learning environments in terms of students’ and teachers’ gender, school level, and school location. The study was designed to investigate the underlying significance of students’ and teachers’ perceptions of their classroom learning environments in the teaching and learning of mathematics in Bhutanese school contexts. This is because both the students and teachers are the major observers of the educational process in any educational contexts.
The study involved both quantitative and qualitative aspects of data collection. Firstly, the Mathematics Classroom Learning Environment Survey (MCLES) was administered to a sample of students and teachers respectively. The quantitative data was collected from 608 students and 98 teachers of 22 lower secondary and middle secondary schools in Bhutan during the autumn semester, 2013. Both the student and teacher versions of the MCLES focused on the same perceived aspects of classroom learning environment, which consisted of eight scales (Teacher Support, Student Cohesiveness, Task Orientation, Cooperation, Equity, Critical Voice, Personal Relevance, and Student Negotiation). Semi-structured focus group interviews and face-to-face interviews with selected students and teacher participants were conducted respectively in three case study schools.

The study found that students and teachers generally perceived their classrooms favorably, but there were differences in their perceptions of some MCLES scales in terms of gender, school level, and school location. Results of the study also showed that numerous contextual factors such as teachers’ professional development, and availability of material resources interacted significantly with student and teacher characteristics, influencing respondents’ perceptions of classroom learning environments.

The findings of the study will provide teachers, educational leaders, and policy makers in Bhutan with new insights into how the learning environment is perceived in Bhutanese mathematics classrooms. From the Bhutanese perspective, this is important because of the country’s Gross National Happiness (GNH) philosophy. Understanding perceptions is important because it goes hand-in-hand with happiness. The recommendations, implications, and suggestions for future research are also discussed.
Dedication

To my late father, Sithar Dorji, whom I missed along with this journey of endeavor. I remember him as a great inspirer of my life, as I complete my thesis.

To my country-Bhutan, King, and its People, considering myself to be lucky to have born, educated, served and lived in this great land of Dragon and Happiness.

Lastly, to all my teachers for showering me with the fountains of their wisdom and knowledge in making me a teacher and giving me a new life.
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Last but not the least, all my research participants – students and teachers from those 22 participating lower secondary and middle secondary schools in Bhutan – deserve special gratitude. This is because without their cooperation and support, my project would have remained incomplete. They all have been really wonderful participants.

Finally, my wife, Dema deserves special thanks for her understanding and love throughout the preparation of this thesis, and taking care of our four children - Lham Tshering, Yeshey Choden, Pema Lhawang Choden and Dechen Norbu, who are my future aspirations.
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List of Abbreviations

ANOVA  Analysis of Variance
CAPSD  Curriculum and Professional Support Division
CLES   Constructivist Learning Environment Survey
CERD   Centre for Educational Research and Development
DCRD   Department of Curriculum Research and Development
ECR    Extended Classrooms
GNH    Gross National Happiness
HDI    Human Development Index
HSS    Higher Secondary School
ICEQ   Individualised Classroom Environment Questionnaire
LSS    Lower Secondary School
MCLES  Mathematics Classroom Learning Environments Survey
MSS    Middle Secondary School
MoE    Ministry of Education
NAPE   New Approach to Primary Education
NCTM   National Council of Teachers of Mathematics
NBIP   National-based In-service Programs
NFE    Non-Formal Education
NSB    National Statistics Bureau
PPD    Policy and Planning Division
RCSC   Royal Civil Service Commission
RUB    Royal University of Bhutan
SBIP   School-based In-service Programs
SD     Standard Deviation
WIHIC  What Is Happening In this Class
Statement of Original Authorship

The content of information contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature:

Date: August 11th, 2015
Chapter 1: The Context and Overview of the Study

1.1 An Overview

This study explored Bhutanese eighth grade students’ and teachers’ perceptions of their classroom learning environments in relation to the new mathematics curriculum. The study aimed to identify and examine various contextual factors which may influence the mathematics classroom learning environments, which in turn might affect the process of curriculum implementation.

The national curriculum reform 2005 mandated the introduction of a new mathematics curriculum in Bhutanese secondary schools, which was implemented in 2008 for year 8 classes. The current Bhutanese school mathematics curriculum closely and explicitly follows principles and standards established by the National Council of Teachers of Mathematics (NCTM) (Wagner, 2010). The researcher noted that this was a big departure from the earlier mathematics curriculum, in which the classroom learning environment was dominated by teachers’ traditionalist beliefs and practices. This curriculum change in mathematics education and the researcher’s reflection on the new classroom learning environment provided the motivation to carry out this study.

The researcher, being a teacher and teacher educator for the last 18 years, has seen immense changes in the Bhutanese education system. Several changes are further proposed by the Ministry of Education, aiming to help students to discover their own talents, realise their potential, and develop a passion for life-long learning. One such major change is the concept of Gross National Happiness (GNH) education, which has been infused into Bhutanese school systems since 2010.
(Rinchen, 2014), and aims to provide relevant and meaningful education to Bhutanese children.

The researcher is currently a lecturer in one of the two colleges of education in Bhutan. As a teacher educator, he has a keen interest in the issues related to the classroom learning environment, the teaching and learning of mathematics, sociocultural issues in mathematics education, and educational assessment. In this study, the researcher held both the role of an insider as well as outsider. During the survey, the researcher took the role of an outsider, visiting schools for the administration of surveys to teachers and students. On the other hand, during the qualitative phase of the study, he assumed the role of an insider, as he was involved personally with the students and teachers in the interviewing process. Being in one of the premier institutes, the researcher is professionally known to many principals and teachers in Bhutan. However, the researcher cautiously differentiated his professional role and researcher’s role during the entire process of the research study.

1.2 The Context of the Study

This section sets an immediate context of the research study. It starts with a brief overview of the Kingdom of Bhutan, and then highlights its geo-political context, socio-cultural context, and education system and curriculum reform in mathematics education. This unique contextual information is important and necessary to justify the whole study.

1.2.1 Geo-political Context

Bhutan is located in the Eastern Himalayas, between India and China, extending over an area of about 39,800 square kilometers (DrukAir, 2013). It is locally known as the Drukyul, which means the land of the Dragon. Its altitudes vary from about 180 metres in the south to more than 7500 metres in the north above sea level (National
Statistics Bureau[NSB], 2013). Bhutan has an estimated population of 760,192 and its annual population growth rate is 3.5 percent (National Statistics Bureau [NSB], 2013). Administratively, it is divided into 20 districts and 205 blocks at local levels, and at the centre, the government comprises 10 ministries with their constituent departments and divisions.

Bhutan, after 100 years of benevolent monarchy (1907-2008) became one of the youngest democracies in the world in March, 2008 (van Balkom & Sherman, 2010). Some of the basic facts about Bhutan along with its location are given below.

![Map of Bhutan](http://www.ilike2learn.com)

**Figure 1.1 Location of Bhutan in Asia**
*Source: (http://www.ilike2learn.com, 22.10.14)*

The general literacy rate currently recorded is 63.02%, while the youth literacy rate is 86.2% (National Statistics Bureau[NSB], 2013), against which the rate of unemployment stands at 9.5% (Kuensel Corporation of Bhutan [KCB], 2014). This is indicative of the level of human development the country has attained. According to the UN Human Development Report (United Nations Development Programs [UNDP], 2013), Bhutan falls into the medium human development group with its HDI value as 0.538. This gives the country a rank of 136 out of 187 countries with comparable data. The HDI of South Asia as a region in 2010 was 0.548, which placed Bhutan below the regional average. Table 1.1 shows the HDI for six basic
dimensions: health, education, inequality, poverty, gender, and income for Bhutan for the year 2013. However, it must be noted that the human resource development in Bhutan, as anywhere in the world, must be attributed to its education system as a part of its socio-economic development process.

Table 1.1

HDI for Six Basic Dimensions of Health, Education, Inequality, Poverty, Gender and Income for Bhutan

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Indices/Names</th>
<th>Index Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inequality</td>
<td>Inequality-adjusted HDI</td>
<td>0.465</td>
</tr>
<tr>
<td>Health</td>
<td>Life expectancy at birth (years)</td>
<td>68.29</td>
</tr>
<tr>
<td>Education</td>
<td>Mean years of schooling</td>
<td>2.30</td>
</tr>
<tr>
<td>Income</td>
<td>Gross national income (GNI) per capita (2011 PPP $)</td>
<td>6,774.89</td>
</tr>
<tr>
<td>Poverty</td>
<td>Population in Multidimensional Poverty (%)</td>
<td>0.119</td>
</tr>
<tr>
<td>Gender</td>
<td>Gender Inequality Index</td>
<td>0.495</td>
</tr>
</tbody>
</table>

Source: UNDP, 2013: National Human Development Report for Bhutan

Bhutan has recently become globally known for its distinct development philosophy of Gross National Happiness (GNH), which has drawn the attention of the world as a powerful idea, challenging the dominant worldview of materialism, consumerism and GDP as central to the wellbeing of people (Royal University of Bhutan [RUB], 2011). Thus, in order to enhance the quality of education, the GNH approach to classroom learning, involving critical pedagogy and contemplative education was proposed to be instituted across the university colleges and institutes in Bhutan (Young, 2012). This was expected to make learning more inquiry-based, reflective, engaging and enjoyable, which is consistent with GNH values and principles (Young, 2012). Similarly, in order to address educational issues based on the four core pillars of GNH, the Ministry of Education during the period 2005-2008
coined its own five pillars, which comprise of teachers, curriculum, infrastructure, wholesome education, and values education (Namgyel, 2011).

Bhutan is a multi-cultural society that reflects a wide diversity in terms of culture, ethnicity, language and customs (DrukAir, 2013). The main ethnic groups making up the population of Bhutan includes Ngalops (people from northern and western Bhutan), Sharchops (people from eastern and central Bhutan), and Lhotshampas (people from southern Bhutan). Most Bhutanese people are Buddhists (75%), Hindus (20%), and other religious groups (5%), and about 24 vernaculars and dialects are spoken throughout the country (Namgyel, 2003). Almost eighty percent of people live in sparsely populated areas (localities with fewer than 500 persons), and only 20 percent reside in urban areas. The capital city, Thimphu, situated in the Western region, is the largest city, with over 98,000 inhabitants (National Statistics Bureau[NSB], 2012). Bhutan, hidden in the folds of Eastern Himalayas, developed its own unique civilization and identity, derived largely from a rich Buddhist religious and cultural heritage (DrukAir, 2012). Bhutanese social structure is characterized mainly by subsistence economy, recognition of bonds of kinship, and egalitarian relationships (Wangyal, 2010), which provide distinct lifestyles, traditions, and culture to its people.

1.2.2 The Bhutanese Education System

Although monastic form of education has been existed long before, the secular system of education in Bhutan has a short history, and is characterised by its rapid growth and expansion. Until the late 1950s, education in Bhutan was mainly monastic, where literacy was confined to the monasteries (Footprints Recruiting, 2012). Many Bhutanese children used to undergo monastic education, in which knowledge, skills, and values were transmitted orally. The central monastic body,
district monastic centres and private monastic institutes used to be the sole local source of schooling in Bhutan.

A modern education system in secular form was introduced to the country in 1961, with the establishment of several schools along with other development activities (Sherab, 2013). Bhutanese schools then followed curricula and textbooks directly from India, which were Anglo-Indian in nature. English became the medium of instruction in Bhutanese schools with the introduction of modern education to the country, but all students are taught dzongkha, the national language of Bhutan, as a compulsory subject across all grade levels.

Bhutan has been striving for the attainment of its primary goal of providing free basic education to all Bhutanese children, and still today education remains a priority among all its development activities. The government provides free education to all students until grade 10, and scholarships to students who meet the requirements for higher and professional studies (Footprints Recruiting, 2012). Until 2002, Bhutan did not have its own university; thus, many students had to pursue their higher studies abroad, especially, in India, Australia, Canada, and the United Kingdom. So, the establishment of the Royal University of Bhutan (RUB) with its ten constituent colleges in 2003 was a significant milestone in the history of the education system in Bhutan. Since then, the university has been trying to improve and diversify programs that cater to higher education needs of Bhutanese children.

The formal education system has been expanded since 1961 to address the basic educational needs, and develop the human resources required for the socio-economic development of the country (Namgyel, 2011). Within 40 years of its modernization, the education system has been expanded from about 11 schools prior to the first Five Year Plan in 1961 to 753 schools and institutes in 2013, spanning
primary schools to tertiary institutes (Policy and Planning Division [PPD], 2013). This has been accompanied by rapid growth in the enrolment of students. From about 400 students in the early 1960s, the total enrolment has increased in all levels of formal education and tertiary institutes in Bhutan to 190,092 as of March 2012, reflecting a growth of about 21% since the start of the tenth Five Year Plan in 2008 (Policy & Planning Division[PPD], 2012).

The secular education system in Bhutan is structured using the 7:4:2 model, with seven years of primary education, four years of secondary education, and two years of higher secondary education (Namgyel, 2011). Table 1.2 below describes the current education structure, which consists of the following levels and grades corresponding with students’ age level.

**Table 1.2**

Current Education Structure with Levels, Grades corresponding to Students’ Ages

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Grades</th>
<th>Students’ Age (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preschool</td>
<td>-</td>
<td>3 to 5</td>
</tr>
<tr>
<td>Lower Primary</td>
<td>Prep to Grade 3</td>
<td>6 to 9</td>
</tr>
<tr>
<td>Upper Primary</td>
<td>Grade 4 to 6</td>
<td>10 to 12</td>
</tr>
<tr>
<td>Lower Secondary</td>
<td>Grade 7 to 8</td>
<td>13 to 14</td>
</tr>
<tr>
<td>Middle Secondary</td>
<td>Grade 9 to 10</td>
<td>15 to 16</td>
</tr>
<tr>
<td>Higher Secondary</td>
<td>Grade 11 to 12</td>
<td>17 to 18</td>
</tr>
<tr>
<td>University</td>
<td>Undergraduates</td>
<td>19 +</td>
</tr>
</tbody>
</table>

Secondary school education in Bhutan refers to the full program of education provided in accordance with the government-approved curricula and availed to students who have completed primary education (Dukpa, 2000). The three types of secondary schools currently operating within the Bhutanese education system are: lower secondary(year 7 & 8), middle secondary (year 9 & 10), and higher secondary.
(year 11 & 12) schools (Policy & Planning Division[PPD], 2012). However, for the purpose of the study, secondary schools include only the lower and middle secondary schools in which grade 8 classes are taught. As per the annual education statistics 2013 (Policy & Planning Division[PPD], 2013) there were 206 secondary schools (92 lower secondary schools, 61 middle secondary schools and 53 higher secondary schools) in these three categories with a total enrolment of 122,616. The secondary school completion rate was recorded at 74.2% for the year 2012 (National Statistics Bureau[NSB], 2012).

1.2.3 Mathematics Education in Bhutan

Before the curriculum reform began in the 1980s, Bhutanese schools followed school curricula that had an Anglo-Indian influence. This was largely due to the fact that it was a period of adoption and learning (Namgyel, 2011). Bhutan first initiated the reform in school curricula when the New Approach to Primary Education (NAPE) was launched as the nation-wide program in 1986. Since then, it has been trying to make the school curricula as relevant and meaningful as possible to the students and in the context of Bhutan. With the introduction of this model of education program, the primary school curricula were ‘Bhutanised’ with partial success (Dukpa, 2000). However, it did not have much of an effect on the secondary school curricula, particularly in mathematics education.

Policy makers, educators and teachers in general felt the need to bring further curricular changes at various school levels. Hence, education leaders in Bhutan sought to develop a uniquely Bhutanese curriculum that addressed the Bhutanese contexts and aligned with international foci (Wagner, 2010). There was constant effort from curriculum developers, teacher educators and field teachers, and the departments and organisations concerned to review and revise the school curricula.
Finally, the Ministry of Education (MoE), in consultation with the Royal University of Bhutan approved the redevelopment of the school mathematics curriculum for preprimary to grade 12 in 2004. Hence, a new school mathematics curriculum framework was developed and published in 2005. Based on this new curriculum framework, all textbooks, teachers’ guides and manuals were to be developed accordingly. Thus, as a part of this reform process, the new mathematics curriculum for secondary schools was developed and implemented in 2008.

Mathematics education in Bhutan starts with the primary mathematics curriculum, which provides the bases for various mathematics courses at higher levels. As a subject, mathematics is taught compulsorily until grade 10. The mathematics syllabus is based on the school mathematics framework (Curriculum & Professional Support Division [CAPSD], 2005), which emphasizes the need for a balance between acquisition of conceptual mathematics knowledge, processes and attitudes (Peer, 2011). This curriculum framework encapsulates that the thrust of mathematics education in Bhutan is to prepare students to be competent and effective future citizens in order to produce a mathematically competent society (Curriculum & Professional Support Division [CAPSD], 2005).

The curriculum is designed to enable students to view the pursuit of mathematics as meaningful and useful, and is prescribed by the Department of Curriculum and Research Development (DCRD) for use by both students and teachers. Teaching of new mathematics curriculum aims at nurturing the students as co-constructors of mathematical knowledge and the teacher as the facilitator of learning in the mathematics classrooms (Peer, 2011). So, its ultimate aim is to motivate students to learn and value mathematics as an important tool in helping
them to explore their natural world (Peer, 2011) and developing critical problem solving skills and communication skills for their life.

More recently, in order to enrich and improve the process of education, and make curriculum and learning more enjoyable and relevant, the Bhutanese government has put all its efforts and means into infusing GNH values and principles into school education. The philosophy of GNH, which remained at a macro level for good governance, socio-economic development, environmental conservation, international relations, and job classification, was introduced into Bhutanese schools and institutions in 2010 (Rinchen, 2014). In this sense, although the mathematics curriculum reform was initiated in 2005, it aligns well with this policy in terms of its aims of making the curriculum and learning in mathematics enjoyable and meaningful to Bhutanese learners. To this end, this current research is considered as significant and timely to contribute towards this big goal of GNH education in Bhutan.

1.3 Background to the Study

Curriculum change and reform is a continual process in any education system geared towards improving the quality of classroom instruction and motivating students to learn, which ultimately leads to improvement in the overall quality of education in the country. Thus, taking into consideration the changing needs of the Bhutanese society as well as international trends in mathematics education, the curriculum reform was initiated in Bhutan to improve the quality of mathematics education in 2005 (Curriculum & Professional Support Division [CAPSD], 2008a). The main aim of this reform was to move from a teacher-centred approach in teaching mathematics to a more student-centred one and to make mathematics more meaningful to learners (Lai, 2010). The new Bhutanese school mathematics curriculum, which is based on
the standards set by the National Council of Teachers of Mathematics (NCTM) (2000) has been implemented since 2008, particularly in eighth grade classes.

Curriculum is considered to be an important and critical lifeline of education (Centre for Educational Research & Development [CERD], 2007) in any country. It was also claimed, “Curriculum is the soul of the education system. It is important to ensure that the curriculum offered in our schools is relevant to the changing needs and priorities of the country” (Policy & Planning Division[PPD], 2012, p. 8). The significance of this curriculum reform lies in its focus on quality education in the Bhutanese context, which is explicitly emphasized in the following statements (Curriculum & Profesional Support Division [CAPSD], 2008a).

Provision of quality education for Bhutanese children is a cornerstone policy of the Royal Government of Bhutan. Quality education in mathematics includes attention to many aspects of educating young children. One is providing opportunities and believing in our children’s ability to understand and contribute to the advancement of science and technology within our culture, history and tradition. The type of education we provide to our children must reflect the current trends and requirements, and be relevant and appropriate to their contexts and life experiences (p.1).

The school mathematics curriculum, therefore, has been changed to reflect research around the world that shows how to help students better understand the beauty of mathematics and its utility (Curriculum & Profesional Support Division [CAPSD], 2008b). The initiative of this national curriculum reform, was a unique opportunity to redefine not only the appropriate curriculum content, but also to reconsider the most appropriate pedagogy to achieve the desired student learning outcomes (Priest, 2009). Though mathematics education has a long history of marginalizing and disengaging students through traditional teaching approaches
(Lesh & Zawojewski, 2007), it can be argued that a review and change of the curriculum and teaching practices is timely in Bhutanese school contexts.

The new mathematics curriculum envisions constructivist approaches to teaching and learning of mathematics and it requires a change in the learning environment to include more group work and pair work with an increased emphasis on communication between students and teachers (Curriculum & Professional Support Division [CAPSD], 2008a). This is because the classroom learning environment has a critical role to play in the efficacy and success of curriculum implementation (Centre for Educational Research & Development [CERD], 2007). The classroom learning environment is partly influenced by the curriculum, and it can be a reflection of curriculum implementation.

It has been argued that in order to stimulate and optimize student learning and learning environments, it is important for teachers and researchers to know about students’ perceptions of this environment and the factors affecting these perceptions (den Brok, Fisher, Richards, & Bull, 2006). According to Yan and Kember (2003), the curriculum and the classroom learning environment not only influence the way in which students behave in class and their approach to study tasks, but also the nature of teacher-student and student-student relationships, as well as students’ academic self-concept. So, the school curriculum should be cognizant of contextual factors such as the students’ characteristics and teachers’ values, the school ethos, the availability of resources and the perceived problems in the existing situation (Yan & Kember, 2003). In addition, the curriculum and the classroom environment significantly influence one another, and it is important to know the relationships between the two variables.
According to Fraser (2001), research on the classroom learning environment has practically and theoretically reached its maturity, offering the potential for understanding the classroom as a vital component of the curriculum. He further argued that curriculum consists of not just contents and outcomes, but also of places, typically classrooms, where the actual business of learning is transacted. Dorman, Adams and Ferguson (2004) noted that research into the classroom learning environment has usually focused on students’ perceptions of classroom life. Research conducted over the last several decades has shown the quality of the classroom environment in schools to be a significant determinant of student learning outcomes (Fraser, 1998a). In other words, students tend to learn and perform better when they perceive their classroom environment more positively and to perform worse when their perceptions are negative (Fraser, 2001; Murugan, 2013; Shadrek, 2012). Thus, the classroom learning environment has become a matter of concern to educators, researchers, and administrators of the school system and parents (Shadrek, 2012).

The past several decades have witnessed the rapid expansion of research on teachers and students’ perceptions of classroom learning environments both in secondary schools and in university classrooms (Dart, Burnett, Purdie, & Boulton-Lewis, 2000). This research has now reached a stage of notable diversification and internationalization (Fisher & Khine, 2006). However, despite this growing interest in the field of learning environment research in many countries, there have been few studies that have investigated the effects of curricular change on perceptions of classroom learning environment, particularly in Bhutanese contexts. Thus, the current study focuses on understanding the nature of the mathematics classroom learning environment in Bhutanese secondary schools as perceived by grade 8 students and their teachers in relation to the new curriculum. This may help to
conceptualise happiness in the mathematics classrooms, contributing to the realisation of Bhutan’s national goal of ‘Gross National Happiness’ (GNH).

Until recently, given the nature of the curriculum, a Bhutanese mathematics classroom situation was generally characterised by teacher-centeredness, discipline-orientation, large class size, and lack of material resources. The emphasis was on the physical environment rather than the psychosocial environment. However, of late, emphasis has shifted, and it is generally believed that teaching and learning should happen in an environment that is friendly, safe, positive and supportive, which encourages exploration, experiment, creativity and innovation (National Institute of Education [NIE], 2005). In addition, there are two major beliefs that underlie current conceptions of learning: firstly, learning is constructive rather than reproductive, and secondly, it is primarily a social, cultural, and interpersonal process governed as much by social and situational factors as by cognitive ones (Centre for Educational Research & Development [CERD], 2004). This implies that creating a learning environment that is characterized by learners’ active participation is very important in learning. Hence, the effective teaching-learning process requires the consideration of the learners’ as well as teachers’ perspectives of their classroom environment, the knowledge of which may help bring about a positive learning environment (Centre for Educational Research & Development [CERD], 2004).

1.4 Problem Statement and Purpose of the Study

Bhutan is in the process of implementing a new curriculum in mathematics. However, there is a dilemma being experienced by many mathematics teachers regarding how this curriculum change will impact on their classroom practices. On the one hand, the new curriculum proposes many changes to existing classroom practices. This places new demands upon teachers and raises expectations of them.
On the other hand, teachers are constantly guided by their old beliefs about the classroom environment and mathematics teaching.

To this effect, such a phenomenon becomes a concern because students’ and teachers’ perceptions of classroom learning environments would significantly influence the students’ learning of mathematics, and affect teachers’ professional practices. More importantly, it becomes an important variable in how well the new mathematics curriculum is adopted and implemented. Thus, though the new school mathematics curriculum envisions a constructivist classroom learning environment, it is unclear whether such a change is occurring.

The classroom learning environment is central to student learning, and many researchers have acknowledged the significance of students’ and teachers’ perceptions of their learning environment (Jamtsho, 2001). It was noted that teachers and educators often talk of a classroom’s climate, environment, atmosphere, or ambience, and consider it to be important and influential in terms of student learning (Fraser, 1989). However, they rarely include classroom environment measures among their evaluation procedures; but they rely exclusively on assessing academic achievement and pay little attention to the quality of the learning environment (Fraser, 2001).

Fraser (2001) questioned the impact of a new curriculum as a main factor in the classroom learning environment, and instead emphasised the significance of the quality of the classroom learning environment, amongst many other issues. This is because success or failure of the curriculum implementation depends on how appropriately the learning environment is actually being created by teachers in their classrooms. In other words, the introduction of a new curriculum requires changes in skills, practices and beliefs of those classroom teachers (Dukpa, 2000), which
depends on how the teachers perceive their learning environments and respond to them accordingly. Hence, the study of classroom learning environment cannot be separated from the issue of the curriculum implementation.

This research study on the Bhutanese students’ and teachers’ perceptions of their mathematics classroom learning environment is urgently needed and timely. The implementation of the new mathematics curriculum and the pressure to improve performance in mathematics in Bhutanese schools offer the researcher an opportunity to carry out the study. The findings of the study are expected to contribute towards a better understanding of how teachers perceive mandated changes to their practices as prompted by many reforms in mathematics education (Cox, 2009).

This current study aimed to examine the key research question – What is the perception of the nature of their mathematics classroom learning environment under the framework of the new curriculum in Bhutanese secondary schools? In an attempt to find an answer to this research problem the following three subsidiary questions were used.

RQ.1. What are the perceptions of Bhutanese 8th grade students about their mathematics classroom learning environment in relation to the implemented new mathematics curriculum?

RQ.2. What are the perceptions of Bhutanese 8th grade teachers about their mathematics classroom learning environment in relation to the implemented new curriculum?

RQ.3. What are the unique contextual factors that influence the mathematics classroom learning environment in Bhutanese schools?

Thus, the purposes of the current study were to explore the nature of the mathematics classroom learning environment as perceived by Bhutanese eighth grade students and their teachers, and examine the contextual factors affecting the
classroom environment that have the potential to either facilitate or impede the effective implementation of the curriculum. The study is primarily concerned with how the new curriculum has influenced perceptions of the classroom learning environment in Bhutanese eighth grade mathematics classrooms.

Furthermore, it is important to convince teachers and administrators to recognize the new curriculum materials that will promote their goals of creating “rigorous, constructivist-based mathematical environments” (Goldsmith & Mark, 1999, p. 41). The study was also expected to further validate the previous class learning environment instruments: the ‘What Is Happening In this Class’ (WIHIC) questionnaire (Aldridge, Fraser, & Huang, 1999) and the Constructivist Learning Environment Survey (CLES) (Taylor, Fraser, & Fisher, 1997) in Bhutanese school contexts, contributing to the field of learning environment research. Given the context, the study also focused on the differences between students’ and teachers’ perceptions of their classrooms, which can contribute to the enhancement of theoretical knowledge of the learning environment.

1.5 The Overview of Research Design

This mixed-methods study examined the nature of the mathematics classroom learning environment as perceived by Bhutanese eighth grade students and teachers during the time of the implementation of a new mathematics curriculum. The study adopted both a positivist as well as an interpretive methodological framework, guided by social constructivist perspectives. This allowed the researcher to gain an authentic understanding of the perceptions of the classroom learning environment of the participants in the context of the classroom setting (Priest, 2009), and to explore contextual factors which influence the classroom environments.
The study employed both quantitative and qualitative methods for data collection. Survey questionnaires (for teachers and students) containing only pre-coded items were used for quantitative data collection. The qualitative data were generated through semi-structured, face-to-face interviews with teachers and group interviews with students. This involved an explanatory multilevel case study in three selected schools. Thus, the “explanatory sequential mixed-methods design” (Creswell, 2009) was deemed useful mainly to enhance the validity and reliability of the study’s findings, by way of triangulating the data. The overview of the research design is given in table 1.3 below.

Table 1.3

An Overview of the Research Approaches

<table>
<thead>
<tr>
<th>Proposed Research Questions</th>
<th>Data sources</th>
<th>Samples</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are Bhutanese 8th grade students’ perceptions of their mathematics classroom learning environments in relation to the new curriculum?</td>
<td>Student survey/interviews</td>
<td>Students</td>
<td>Reliability tests Descriptive statistics Independent samples t-test ANOVA Reliability tests Descriptive statistics Independent samples t-test ANOVA</td>
</tr>
<tr>
<td>2. What are Bhutanese 8th grade teachers’ perceptions about their mathematics classroom learning environments in relation to the new curriculum?</td>
<td>Teacher survey/interviews</td>
<td>Teachers</td>
<td></td>
</tr>
<tr>
<td>3. What are the unique contextual factors affecting the classroom environment in Bhutanese schools?</td>
<td>Teacher interviews</td>
<td>Students Teachers</td>
<td>Theme-based Analysis</td>
</tr>
</tbody>
</table>

The research instrument, Mathematics Classroom Learning Environment Survey (MCLES), was an adapted version of the two existing instruments – the What Is Happening In this Class (WIHIC) questionnaire (Aldridge, Fraser, & Huang, 1999) and the Constructivist Learning Environment Survey (CLES) (Taylor et al, 1997). Of the eight scales used in the MCLES, five scales (teacher support, student
cohesiveness, task orientation, cooperation and equity) from the WIHIC and the other three scales (personal relevance, critical voice and student negotiation) from the CLES were considered appropriate for the purpose of the current study. This relationship among the three instruments is shown in Table 1.4 below.

Table 1.4
The Use of the WIHIC and CLES scales in the MCLES

<table>
<thead>
<tr>
<th>WIHIC Scales</th>
<th>CLES Scales</th>
<th>MCLES Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Student Cohesiveness</td>
<td>1. Shared Control</td>
<td>1. Teacher Support</td>
</tr>
<tr>
<td>2. Teacher Support</td>
<td>2. Personal Relevance</td>
<td>2. Student Cohesiveness</td>
</tr>
<tr>
<td>5. Investigation</td>
<td>5. Student Negotiation</td>
<td>5. Equity</td>
</tr>
</tbody>
</table>

The survey samples in this study included 608 grade eight students and their corresponding 98 mathematics teachers. Interview samples comprised 31 students and 5 mathematics teachers from three case study schools. The details of the sampling and participants are discussed in Chapter 3.

1.6 Significance and Scope, and Delimitations of the Study

This section of the chapter discusses the significance of the study and its scope in the field of learning environment research, and also the limitations of the study.

1.6.1 Significance and Scope of the Study

This current study about the perceptions of the classroom learning environment is important and unique for several reasons. First, this research study was expected to
address gaps in existing knowledge by exploring the extent of relationships between the curriculum intentions and students’ and teachers’ perceptions of the classroom learning environment across secondary schools in Bhutan. Thus, the study will add to the theoretical knowledge of the field of learning environments as a whole, and complement findings from past research.

Based on the research findings, informed decisions can be made on future curriculum changes, and improvements can be made to teaching methods, facilities, and assessment procedures; and accordingly, appropriate intervention strategies may be proposed to improve the mathematics classroom environment. Thus, the study will be useful for the overall improvement in quality of mathematics education in the country, with far-reaching implications for producing a numerate and mathematically-skilled workforce in the country (Curriculum & Professional Support Division [CAPSD], 2005).

The findings of the current study will provide insights into implications of how the field teachers view their classrooms and their role in promoting an environment which is conducive to student learning. As a result, the teachers will be encouraged to think about ways to facilitate learning in their classrooms. In addition, the results of the study will have implications for teacher education with respect to the ways in which teachers are prepared to create positive classroom learning environments.

The implementation of the new mathematics curriculum is a big departure from the traditional classroom practices, and it can be considered as “an instance of the educational change process” (Dukpa, 2000, p. 5), which involves the development of new concepts, skills and practices. It further involves the use of new materials, new teaching approaches, and changes in beliefs. Thus, the significance of
this study lies in its examination of how the teachers and students perceive the nature of their mathematics classroom learning environments as an instance of change in their classroom practices.

The findings of this study will prove valuable to educational leaders, school principals, and teacher educators in Bhutan, as they will provide insights into the impact of positive perceptions of the learning environment in promoting effective classroom practices. This should enable these educators to understand the benefits, values and impact of the classroom environment, identify significant barriers to student learning and explore the evaluation of teaching practices (Centre for Educational Research & Development [CERD], 2004).

To date, there is no evidence that a research study on the mathematics classroom learning environment in a school setting has been conducted in Bhutan. The study will open avenues for future research in learning environments and curriculum reform driven research in the Bhutanese school context. It will, thus, lead to further enquiry into the important but often neglected areas of the critical role of students’ and teachers’ perceptions of their classroom environment in determining the effective implementation of the curriculum.

1.6.2 Limitations of the Study
The study sought to collect and analyze data on the perceptions of teachers and students about what the classroom learning environment was, and how it was perceived in relation to the aims of the new mathematics curriculum. Since the views collected were the self-reported perceptions of what they say and what they do, they may or may not be reflected in actual classroom practices. Further, it focused on
only one grade level, that is, grade eight, and the other grade levels were not included in the study samples.

The issue of sampling was one of the main drawbacks in this study. The perceptions of the classroom learning environment would have been better understood by involving teachers and students from other grade levels of lower secondary and middle secondary schools, and even higher secondary schools. The findings were based on the responses of grade eight students and their corresponding teachers from 22 selected lower secondary and middle secondary schools. So, their perceptions and views really may not be representative of the overall perceptions of the mathematics classroom learning environment. Hence, the survey sample size itself constrained the study, because it was difficult to include a large enough number of teachers and students for the study’s purposes.

Finally, the study was also constrained by time and other resources available to the researcher. This resulted in limited data collection, either in terms of the surveys or the interviews. For example, the researcher was able to interview only a few teachers and a few groups of students in each of the three schools due to the little time the researcher had at his disposal.

1.7 Conceptual Definitions of Terminologies used

The various key terms and concepts used in this study are defined and explained briefly as follows:

*Class* means the grade level or standard students are attending during their school education period in Bhutan.

*New curriculum* refers to the new school mathematics curriculum which was implemented in Bhutanese lower and middle secondary schools for eighth grade (Curriculum & Profesional Support Division [CAPSD], 2008a).
Perceptions are defined as views or opinions held by an individual resulting from experience and external factors acting on the individual (Susuwele-Banda, 2005, p. 13). Perceptions can be either positive or negative. Positive perceptions reflect an individual’s positive feelings, emotions, attitudes and his or her optimistic views towards something or somebody, and negative perceptions refer to those negative feelings, emotions and attitudes towards something or somebody.

Curriculum implementation refers to the actual use of a curriculum or a syllabus by classroom teachers, and it is a critical phase in the cycle of planning and teaching a curriculum (Marsh, 2004).

Secondary school is a program level of school education that is used in Bhutan. It consists of three levels – lower secondary, middle secondary and higher secondary schools. Lower secondary school has grade 8 as its graduating class, and is basically meant for the admission of 7th and 8th graders only. However, in Bhutan we have class 7 & 8, even in some middle secondary schools, and most of them have primary classes as well. Hence, for the purpose of the study, secondary schools include only the lower and middle secondary schools, but which constitute only year 8 classes.

The concept of environment, as applied to educational settings, refers to the atmosphere, ambience, tones or climate that pervades the particular setting (Dorman, Aldridge, & Fraser, 2006; Dorman, 2008).

Learning environment refers to the social, physical, psychological and pedagogical contexts in which learning occurs and which affect student achievement and attitudes (Fraser, 1998b). According to Wahyudi (2004), the classroom learning environment encompasses the atmosphere, character, ambience and the ethos of the classroom that can influence the learning process.
1.8 Outline of the Thesis

This thesis comprises six chapters. The first chapter introduces the study by providing the contextual information of the research study. This encompasses a brief outline of the geopolitical background of Bhutan and its education system, and of mathematics education reform. It also highlights the background to the study, research purpose, research problem, and its significance.

The second chapter provides a review of the existing literature relevant to the study, pertaining to two main areas: the classroom learning environment and the curriculum reform and implementation. It highlights a theoretical perspective on which the study is based, that is, social constructivism.

The third chapter presents the broad design and plans of the study, and a detailed discussion of data collection procedures. The general issues pertaining to the research quality standards and the associated ethical considerations arising from the study will be discussed towards the end of Chapter Three.

The fourth chapter presents the results of the quantitative study without interpretations and discussions. The fifth chapter highlights the detailed analyses and results of the qualitative data. Finally, the sixth chapter provides a discussion of the results of both quantitative and qualitative data altogether, and a concluding summary of the study, with recommendations for further research and improvements of classroom learning environment in Bhutanese secondary schools.
Chapter 2: Literature Review and Theoretical Framework

2.1 An Overview

This study focused on how the students and teachers perceived their mathematics classroom learning environment under the framework of the implemented new mathematics curriculum. It involved assessing their perceptions of the learning environment in Bhutanese eighth grade mathematics classrooms using an adapted learning environment instrument (i.e., MCLES). In addition, the study also aimed to examine the contextual factors that affect the classroom learning environment as well as the curriculum implementation.

This chapter begins by examining the theoretical perspectives of social constructivism relevant to the study, and presents the review of related literature in two broad areas: the field of the classroom learning environment, and the curriculum reform in mathematics education, which highlights the concept of standards-based mathematics curriculum. It is broadly divided into the following five sections.

- Theoretical Perspectives of Social Constructivism (Section 2.2)
- The Classroom Learning Environment (Section 2.3)
- Curriculum Reform and Change (Section 2.4)
- The Conceptual Framework of the Study (Section 2.5)
- Chapter Summary (Section 2.6)

Thus, the current study situates classroom environment theory and standards-based mathematics curriculum – within a theoretical framework of social constructivism as represented by Figure 2.1 below. The literature and various theories within these three broad areas provide the theoretical basis and conceptual
framework for the study, justifying its significance within the given contexts. However, as the literature involves historical perspectives on the theory and origin of learning environment research instruments, the use of some chronologically outdated references were out of place in this chapter. Moreover, the researcher would not undermine those older literatures in the field of learning environment which contribute significantly to the current study by setting a time period as a criterion for search of literature.

![Diagram of Social Constructivism](image)

Figure 2.1 Situating the study within literature and theories

### 2.2 Theoretical Perspectives of Social Constructivism

A social constructivist paradigm guided and shaped the current study, because social constructivism is concerned with what constitutes students’ learning and how to improve their understanding within classroom contexts. However, before the discussion delves further into the ideas of social constructivism, it would be appropriate to consider the concept of constructivism and its key principles.

Constructivism is a philosophy or belief that learners create their own knowledge based on their experiences, and on interactions with their environments (Almala, 2005; Wang, 2008). It is a learning theory that emphasizes learners’
construction of their own understanding and knowledge of the world through experiences and reflection (Howard, Mazintas, & Kanai, 2009). According to Harrington and Enochs (2009, p. 48), “constructivism is a theory of knowing that emphasizes that knowledge is actively constructed by the learner as he/she reorganizes prior knowledge in the light of new experiences.” The concept of constructivism can be explained in terms of its four characteristics: knowledge construction, cooperative learning, meta-cognition in learning, and authentic learning tasks (Loyens, Rikers, & Schmidt, 2009).

- First, students construct their own knowledge, based on their prior knowledge, by going through the process of discovering, transforming, and checking information, and by revising rules when they no longer apply.
- Second, knowledge construction can be fostered through the interactions of the learner with others, recognizing the fact that social negotiation and interaction is important in the process.
- Third, metacognition (knowing about our own thinking) plays a significant role in the learning process, whereby learners preferably acquire new information through self-regulated learning (such as goal setting, self-observation, self-assessment, and self-reinforcement).
- Fourth, authentic learning tasks, including working on problems that are similar to problems that they will encounter later in their life, encourage meaningful learning.

Thus, the central idea of constructivism is that knowledge is actively created and not passively received from the environment, and the learner strives to organise his or her experiences in terms of pre-existing structures or schemas (Begg, 1995; Bodner, 1998; Treagust, Duit, & Fraser, 1996). Constructivism as a concept
constitutes various versions, such as cognitive constructivism, social constructivism, critical constructivism and radical constructivism, which underpin the essence of constructivist theory from different perspectives. However, the current study as a classroom learning environment research is mainly contained within the framework of social constructivism.

Social constructivism in the educational setting was first propounded by Vygotsky in 1978, and it emphasizes the influence of sociocultural contexts in learning and supporting a discovery learning model (Gray, 2005). This learning model implies the teacher’s active role in developing their students’ mental abilities naturally through various paths of discovery (Gray, 2005). Social constructivists claimed that learning is an active process involving others and it depends on social interactions, meaning it can be best understood by taking into consideration of others within an individual’s world (Gray, 2005). Hence, social interactions both between the teacher and the students and among students themselves characterize classrooms, and the interactions among other individuals around them also impact on their interactions (Jamtsho, 2001). The process of continuous interactions that takes place between the individual and others is called the zone of proximal development (ZPD), which allows assessment of the intellectual potential of an individual rather than what the individual has achieved (Gray, 2005).

In addition, proponents of social constructivism view culture and context as important elements in understanding what occurs in society, and that knowledge should be constructed based on this understanding (Kim, 2001). Hence, they assume that a reality is constructed through human activity; knowledge is a human product, which is socially and culturally constructed, creating meaning through people’s interactions with each other and with the environment they live in. Further, social
constructivists believe that learning is a social process, and that the individual’s engagement in social activities leads to meaningful learning (Kim, 2001).

Many researchers and scholars have increasingly based their research practice on social constructivism as a theoretical framework because it recognises the importance of social and personal aspects of learning (McRobbie & Tobin, 1997). Personal aspects of learning determine how an individual constructs meaning as new information interacts with their existing knowledge (McRobbie & Tobin, 1997). It is an accepted fact that there is a reality, but learning is personal and subjective and only exists in the minds of learner. The social view of learning is that it is a personal construction, but it is socially mediated as a result of cultural experiences and interaction with others in a particular culture (McRobbie & Tobin, 1997).

From the constructivist perspective, a learning environment is viewed as “construction of the individuals in a given social setting; an individual’s socially mediated beliefs about the opportunities to learn and the extent to which the social and physical milieu constrains learning” (Lorschback & Jinks, 1999 p. 158). Though learning can be viewed as personal, each individual’s mental constructions are affected by the actions of others in the social setting and the characteristics of the culture in which learning takes place. In other words, a learning environment includes learners’ beliefs about their roles as learners, and others’ roles as facilitating and inhibiting their learning (Jamtsho, 2001; McRobbie & Tobin, 1997). Thus, it is imperative to understand how the teachers and learners view and shape the classroom learning environment, which in turn may affect the way they perceive it.

2.2.1 A Social Constructivist View of the Nature of Mathematics and Teaching

Social constructivists view knowledge as “the outcome of collaborative construction in a socio-cultural context mediated by discourse; learning is fostered through
interactive processes of information sharing, negotiation, and discussion” (Wang, 2008, p.413). Hence, social constructivism is significant in the sense – that it recognizes the interdependence of social and individual processes in the co-construction of knowledge (Palincsar, 1998). However, the teaching and learning mathematics is traditionally based on the pure, objective perspective of the “Old Humanist Mathematicians” (Ernest, 1991, p. 168). In this approach, mathematics is seen as a body of pure, true, objective knowledge, which is independent of human and social values and concerns, with its “infallible-absolutist philosophy” (Ernest, 1991, p. 168). The conservative and hierarchical nature of this approach does not allow teachers and students to exercise their freedom in the process of teaching and learning mathematics.

Clements and Battista (1990) proposed four basic principles of constructivism pertaining to mathematics learning: (i) students actively construct mathematical knowledge rather than passively receive it; (ii) students create their own mathematical knowledge reflecting on their physical and mental actions; (iii) learning mathematics is a process of adapting to and organizing one’s quantitative world; and (iv) learning mathematics is a social process, whereby mathematical ideas and truths are cooperatively constructed through dialogue and interaction. Each of these principles is significant in the sense that they form the basis of a pedagogical framework for teaching and learning of mathematics. However, the theory of social constructivism is mainly concerned with the fourth principle – mathematics learning as a ‘social process’ or ‘sociocultural construction.’ A constructivist view of learning focuses on both the students and the teacher constructing their own meanings from what they have experienced; the process of construction is embedded within a social
setting and the learning is seen as a construction of mental models (Duit & Treagust, 1998).

From the social constructivist perspective, mathematics can be seen as a social construction and there are three main reasons for describing mathematical knowledge in this way (Ernest, 1991). Firstly, mathematical knowledge is based on linguistic knowledge, conventions and rules, and the language itself is a social construction. Secondly, interpersonal social processes are required to turn an individual’s subjective mathematical knowledge into accepted objective mathematical knowledge. Lastly, the objectivity of the mathematical knowledge itself must be understood to be social. Thus, social constructivists view mathematical knowledge as socially constructed and validated and they believe that classroom teaching should reflect this (Neyland, 1995).

Norton, McRobbie and Cooper (2002) argued that “curriculum documents that are essentially investigative reflect theories of learning consistent with major elements of social constructivist theory” (p.37). It is important to recognize students actively constructing their own knowledge from the environment through interaction with physical reality and through social interactions with peers and teachers. Therefore, an investigative teaching approach can be defined in many ways, emphasizing on problem solving, reasoning, communication, use of manipulative materials, group work, and facilitation, while the teachers see themselves as guides, listeners, and observers rather than authorities and answer providers (Norton et al., 2002).

The constructivist theory of learning recognizes learning as an active construction of knowledge based on a priori knowledge structures and influenced by contextual circumstances (Duit & Treagust, 1998). The acceptance of a constructivist
perspective on learning implies the need to change teaching practices to align with current pedagogical principles. This has led to the advocacy of alternative or authentic context-based teaching approaches, in which the teacher plays a crucial role. According to Fernandez, Ritchie, and Barker (2008), there are two contrasting conceptions of learning: one conception sees learning as an individual activity in which the acquisition of knowledge and cognitive skills are transferable commodities, while the other views learning as a sociocultural activity, a collective participation in the construction of knowledge.

It was argued that social constructivism and sociocultural theory can be linked through the fact that they both have the potential to explain children’s development of mathematical knowledge in terms of both individual and social construction under the influence of social and cultural practices (Jaworski, 2003). So, mathematical knowledge is socially constructed and validated, meaning that mathematics is a part of human culture; and it can be considered as a social, cultural and historical entity (Jaworski, 2003). A social constructivist view of learning focuses our attention on the social processes operating in the classrooms by which a teacher promotes a discourse community in which students and the teacher co-construct knowledge (Tytler, 2002b), whereas a socio-cultural theory of learning (Tytler, 2002b) emphasizes the role of language and culture in the construction of knowledge. This theory encourages lots of exploratory activities and talk, and allows the teacher to support high quality conceptual discussion in groups or in the whole class, leading to what is called a “social constructivist approach to teaching mathematics” (Neyland, 1995, p. 45).

A constructivist view of teaching is based on the belief that the occurrence of learning depends on learners’ active involvement in a process of knowledge
construction rather than passive reception of information (Howard, Mazintas & Kanai, 2009; Wang, 2008). Hence, the approaches to teaching mathematics have changed from traditional teaching approach to the constructivist environment where it is distinguished as the construction of knowledge in the minds of the learners (Bodner, 1998). Loyens, Rikers, and Schmidt (2009) argued that constructivist views of learning have brought conceptions of learning to limelight, while conceptions are important determinants of effective learning because students can conceive things differently depending on their educational experiences.

The issue of how students understand mathematical concepts is central to the constructivist teaching-learning process, and it is important to understand the concept of constructivism in relation to teaching and learning of mathematics. Booker, Bond, Sparrow and Swan (2004) argued that since understanding allows ideas and techniques to be adapted to ends, it is invaluable to allow ideas to be developed efficiently and effectively. A constructivist teacher should realize that having taught something does not mean that students have learnt exactly what was envisaged by him or her (Zevenbergen, Dole, & Wright, 2005). It is important for the teacher to use a range of tools and techniques to assess what the students have constructed.

It was argued that teaching mathematics for understanding has always been important issue in mathematics education (Goodell, 2000). Hence, mathematics teachers, teacher educators, and researchers involved in the reform of mathematics education commonly aim to increase students’ understanding of mathematics. However, teaching mathematics with understanding is also a concern in Bhutanese schools because many teachers in field lack proper training and orientation to deal with the new curriculum, which emphasizes constructivist approaches to learning of mathematics. According to Stylianides and Stylianides (2007),
Learning with understanding has increasingly received attention from educators and psychologists, and has progressively been elevated to one of the most important goals for all students in all subjects. However, the realization of this goal has been problematic, especially in the domain of mathematics. To this might have contributed the fact that, although the vision of students learning mathematics with understanding has often appeared in curriculum frameworks, this vision has tended to be poorly described, thereby offering limited support to curriculum development and policy (p.103).

More recently, Barrett and Long (2012) posited that teaching of mathematics depends upon a merging of how teachers view mathematics, and how they perceive mathematics learning. If mathematics is viewed as only a set of rules and procedures to be learned and followed, the teacher restricts his or her role to transferring the knowledge to students, using a method of transmission, lecture, or direct instruction (Barrett & Long, 2012). Whereas, if it is viewed more as functions and relationships, the teacher views his or her role as creating problems or experiences that help students conceptualize these relationships (Barrett & Long, 2012).

In a constructivist classroom, the teacher should acknowledge that students construct a range of mathematical understandings from any given interaction on the basis that they have entered the context from a range of different perspectives and experiences (Zevenbergen et al., 2005). A constructivist perspective recognizes that it is not possible to assume that the teaching of a concept relates to the development of the ideas proposed by the teacher, because there will be a multiplicity of understandings constructed by the students in the classroom (Zevenbergen et al., 2005). Treagust, Duit and Fraser (1996) opined that the constructivist teaching approaches explicitly aim to help students to make the constructions that lead to understanding of the mathematical points of view. According to Tytler (2002a), there are numerous teaching schemes/sequences proposed, which draw strengths from the
theoretical perspectives of various versions of constructivism, which refers to as ‘Constructivist/ Conceptual Change Approaches’ (Duit & Treagust, 2003). However, the critical elements in all of these teaching schemes, considering the students’ prior conceptions as the starting point, are summarized into the following six general principles (Tytler, 2002b, p. 34):

- providing opportunities for students to make their own ideas explicit,
- providing experiences which relate to students’ prior ideas,
- giving opportunities for students to think about experiences,
- giving opportunities for children to try out new ideas,
- encouraging students to reflect on changes to their ideas, and
- providing a supportive learning environment.

2.2.2 Implications of Constructivism for Teaching Mathematics

Social constructivism emphasizes the significance of understanding the social and cultural contexts of teaching and learning mathematics. It must be noted that society and culture influence mathematics in different ways, as each of them have their own historical developments and they interact with the physical world differently (Dhindsa, 2005). The current study intended to explore the perceptions of contextual factors, which are socially and culturally unique to teaching and learning mathematics in Bhutanese schools. In order to improve the classroom learning environment, mathematics reformers and educators propose the use of a variety of teaching strategies that will result in effective teaching and learning (Golashani, 2013). The effective teaching constitutes teaching mathematics for understanding, enhancing mathematics content, using better approaches to teach mathematics (Friesen, 2005), and reversing mathematics misconceptions (Green, Piel, & Flowers, 2008). This implies that the teacher should facilitate the construction of knowledge
for all learners rather than transmission of knowledge (Golashani, 2013) to them. For instance, the teachers’ use of multiple teaching strategies can benefit their students, because each classroom consists of students with different levels of ability to understand mathematical concepts (Golashani, 2013).

Dhindsa (2005) maintained that teaching and learning at schools should be an extension of the learners’ real-life experiences, and their traditional thoughts can influence their learning practices. This implies that teachers should know the cultural diversity in their classes and equip themselves with methodologies to cope with students from diverse cultures to produce optimum learning (Dhindsa, 2005). It further implies that curriculum developers should know the cultural composition of students in schools in order to develop or modify the curriculum to optimize its effectiveness for mathematics learning (Dhindsa, 2005). Hence, teachers’ and students’ cultural backgrounds can be used to develop culturally sensitive pedagogies, and new curriculum that will not reflect the cultural dominance of majority groups.

As far as the Bhutanese context is concerned, there are very few mathematics teachers and educators whose practices reflect that of “progressive educators” (Ernest, 1991, p. 181). This group of educators emphasizes the cultural contexts by engaging students in thinking about local examples, introducing them to various areas of mathematics that can be taught in relation to local ideas, and making them aware of various roles that sociocultural contexts could play in learning mathematics. The purpose of such an approach is to have the students gain confidence, creativity, and self-expression through mathematics, so that they are ready to face real problems in the future. In other words, the approaches to teaching and learning of mathematics should be context-based, and the classroom teachers should try to incorporate best
practices and values that are adaptive to the changing time and current needs of the Bhutanese society, so that the learners see mathematics learning as meaningful and relevant to their day-to-day life.

As pointed out earlier, Bhutanese teachers’ and students’ treatment of the notion of context is traditionally based on the old humanist perspective of mathematics (Ernest, 1991). Hence, many senior teachers in Bhutan would neither agree with nor adopt a new philosophy of teaching and learning such as constructivism, and would rather prefer to continue with their old traditional classroom practices. This remains one of the challenges in the process of implementing the new curriculum in Bhutanese schools. However, we cannot deny the fact that constructivist philosophy has brought changes in current thinking about mathematics education around the world. The new Bhutanese school mathematics curriculum also envisions a pedagogical change based on the theory of social constructivism and the socio-cultural theory, which would lead to improvement in the teaching and learning of mathematics as an intention and a belief. To this effect, “acknowledging the existence of many flaws in constructing a constructivist learning environment” (Golashani, 2002, p. 1) in Bhutanese classrooms, the desirable way to teach mathematics is through constructivist approaches which depends to a large extent, on teachers’ beliefs and perceptions of mathematics, and teaching and learning of mathematics.

There are practical benefits of constructivist approaches to the teaching and learning mathematics, and changing children’s views on mathematics to see it as a construction of knowledge rather than learning facts and principles. Constructivist theory has greatly contributed to making the learning of mathematics more concrete and challenging, despite its limitations in the learning environment. Thus, in order to
improve the overall quality of classroom learning environments, and ultimately, the quality of education, Bhutanese schools must adopt constructivist epistemology and use constructivist approaches. However, anecdotal evidence indicates that Bhutanese teachers need more orientation to handle social constructivist approaches, and more time to understand the roles of teachers and students in constructivist classrooms and to change their teaching styles.

In addition, in order to advance teachers’ mathematics understanding and improve instructional pedagogy, mathematics educators and researchers must find effective ways to reverse traditionally well-documented teacher misconceptions about mathematical concepts and skills (Green et al., 2008). One possible way could be that the classroom teachers can adopt constructivist approaches and principles in implementing the standards-based mathematics curriculum effectively. However, it depends on identifying ways to encourage and help teachers to make significant changes in their beliefs, because these beliefs can contribute to the success or failure of any changes made to their teaching practices in line with the mathematics curriculum reform (Golashani, 2013).

Thus, the theory of social constructivism not only provides a good framework for research practices in mathematics education, but also a sound theoretical basis for teaching and learning mathematics. In short, teaching within a constructivist classroom environment involves the assimilation of new knowledge and the accommodation of that knowledge within existing knowledge structures, whereby the learner plays an active role in assimilating new knowledge into his or her mental structures (Barrett & Long, 2012).
2.2.3 Bhutanese Cultural Context and Mathematics Learning

In any society and educational system, cultural diversity remains an issue, because the term ‘culture’ represents different meanings in different contexts. Bhutan has its own unique culture that is deeply embedded within Buddhist religion and culture, and shapes the entire Bhutanese way of life – the way people live, eat, dress, behave, and respect one another. Woolfolk (2004) viewed culture as the knowledge, rules, traditions, attitudes, and values that guide behaviours in a particular group of people. It was observed that “culture affects who we are, how we think, how we behave, and how we respond to our environment, and above all, determines how we learn” (Dunn & Marinetti, 2006, p. 3). According to Eaves (2009) “culture can affect learning behaviours in students from highly different education backgrounds and cultures” (p.72). Hence, it was claimed that teachers should be sensitive to the different cultural backgrounds that might influences students’ learning (Michailidou & Economides, 2007).

Wang (2007) was of the view that students’ cultural backgrounds affect their expectations and responses to learning environments. For instance, Asian students generally learn by reproducing, accompanied by rote learning, and are less able to apply their knowledge to practical situations as compared to Western students. Zhu, Valcke, and Schellens (2008) also observed that students’ personal or prior experiences based on their own cultural background greatly impact on how they learn in any learning contexts. Wong and Trinidad (2004) found Asian students to be passive and uncritical learners who have been brought up in an education system where memorization is the norm, teaching content-based and critical thinking rarely stressed. In addition, Asian students typically exhibit shy, passive, reactive, inarticulate, non-collaborative, and timid learning behaviours (Wong & Trinidad,
This is also true for Bhutanese learners, who experienced Eastern educational systems, exhibit very similar learning characteristics, and adopt the Eastern culture and more passive ways of teaching and learning (Yee, 2011).

In the Bhutanese context, teaching of science or mathematics has always been challenging due to several sociocultural reasons. One reason is that cultural and traditional beliefs often put teachers in a disadvantaged position (Rinchen, 2014). It was argued that even at the tertiary institutes most teachers still practice traditional methods of instruction in which students scrupulously take copious notes from the tutors for reproducing them in examinations (Young, 2012). In addition, owing to strong cultural inhibition, students seldom question teachers because teachers are culturally revered as highly learned and questioning or challenging them implies impoliteness, disrespect or indecency on the part of students (Rinchen, 2014). As a result, Bhutanese students remain polite and well behaved, but this restricts application of their reflective and analytical skills in their learning (Rinchen, 2014).

As a part of culture, the issue of language and mathematics is also a concern for the community of mathematics educators and teachers in Bhutan, because the language of mathematics technically speaking is quite different from general usage of language. Communication has been emphasized as one of the process standards of the new Bhutanese mathematics curriculum and students are expected to be able to communicate mathematically and express their mathematical ideas to other students and their teachers (Curriculum & Professional Support Division, 2008). However, in many non-English speaking countries like Bhutan, teaching mathematics in English or their own national or local languages has been one of the critical and complex issues. In Bhutan too, mathematics is currently taught in English, but the challenge lies whether to teach the subject in English or in Bhutanese national language or
other local languages, or used them altogether. Therefore, each government or education system should look for their own suitable means of using appropriate language in teaching mathematics so that students learn mathematics better in the given contexts.

To this effect, Bhutanese cultural contexts as a whole might have implications on how the research participants interpreted and responded to research questions which might have distorted the results of the study.

2.3 Classroom Learning Environment Research

The classroom learning environment remains an important concept in education because it influences students’ learning outcomes (Cetin-Dindar, Kirbulut, & Boz, 2014). Research has shown that when students have the opportunity to be educated in an organised learning environment, their achievement and interest increase tremendously (Fraser, 1998a). Hence, it is important for teachers to take responsibility and be accountable in organizing an effective learning environment for their learners, so that students also become responsible for their own learning. However, it all depends on how the students and teachers perceive their classrooms, so the current study focused on investigation of Bhutanese eighth grade students’ and teachers’ perceptions of their mathematics classroom environments.

This section presents the review of literature on the field of classroom learning environment research, which discusses the concept of classroom learning environment, past research on classroom learning environment, theoretical perspectives of classroom environment research, validation and use of the classroom environment instruments, and the concept and instruments of constructivist learning environments. This framework provides a broad overview of the learning environment literature and theories that are relevant to the current study. As much as
possible, each of the sections is presented in chronological order. The overview of the section is represented in Figure 2.2 below.

![Figure 2.2](image-url)

**Figure 2.2**  Literature on classroom learning environment (CLE)

### 2.3.1 The Concept of Classroom Learning Environment

There are several interrelated and similar terms such as classroom environment, learning environment, classroom climate, classroom psychosocial environment, teaching-learning environment, educational climate and so on, which are used to describe the concept of classroom learning environment. However, many scholars, educators and researchers tend to use all these terms interchangeably.

The concept of environment as used in the study is derived from the social environment referring to broad contexts of the society at large. This in turn could be narrowed down to the concept of learning environment, which can be any place or organizations, both formal and informal. Further it was viewed as a classroom learning environment, which can be physical (e.g., classroom structures, buildings,
etc.) as well as psychosocial (friendliness of people around, caring nature of persons involved) in nature, and finally as the mathematics classroom learning environment, which is the focus of this research study. This conceptualization of classroom learning environment is represented in Figure 2.3.

The learning environment is further conceptualized in two ways – positively and negatively. A positive learning environment refers to the level of warmth and pleasant attitudes among peers and with teachers, whereas the negative learning environment refers to the level of hostility between students and teachers, and students and students (LaRocque, 2008). Perceptions of classroom learning environment refers to how the students and teachers view various aspects of their classroom learning situation as specified by Aldridge, Fraser and Huang (1999) in the WIHIC, and Taylor, Dawson and Fraser (1995) in the CLES, and Dorman (2008) in the abridged version of these two instruments. Hence, the concept of classroom learning environment remains significant in educational setting.

![Figure 2.3 Conceptualization of classroom learning environment](image-url)

*Figure 2.3 Conceptualization of classroom learning environment*
Although the concept of a learning environment can be considered a “subtle concept” (Fraser, 2007), its influence on the process of education has received a great deal of attention from educational researchers during the last few decades (Margianti, Fraser, & Aldridge, 2001). However, different scholars and educators view the concept of the classroom learning environment and its significance from different perspectives. The classroom environment can be defined in terms of the students’ and teachers’ shared perceptions in that particular environment (Fraser, 1998a). This is because there is an advantage of characterizing the setting through the eyes of the actual participants and capturing the data that an outside observer could miss or consider unimportant (Linda & Fraser, 2010).

Fraser (1998a) defined the term “learning environment” as the social, physical, psychological and pedagogical contexts in which learning occurs, and which affect both student achievement and attitudes. Thus, the classroom learning environment involves many relationships that exist between the teacher and students, or among students themselves. It has been claimed that the personal nature of the perceptions of those who are in the environment on a daily basis, is useful in providing a wealth of information and deeper insights into the classroom (Linda & Fraser, 2010).

According to Hiemstra (1991), the educational climate consists of both the physical environment and the psychological or emotional climate, for example, what takes place during the first class to establish a supportive, challenging, friendly, informal, and open atmosphere. Hence, a taxonomy of environmental climate components, comprising ecology (building on classroom characteristics), milieu (individual’s characteristics), social system (interpersonal or group–patterned relationships), and culture (beliefs, values, and expectations) has been developed.
The classroom environment forms an integral part of the learning process, and no teacher or student can be unaffected by it, since it is the learning environment for both the teacher and their students (Marsh, 2004). It is also defined as an array of inner characteristics that differentiate one classroom from another, and that could influence the behaviours of every teacher (Khalil & Saar, 2009). So, the students’ achievement and behaviours are influenced and affected by factors within the classroom.

According to Dorman (2008), the concept of environment as applied to educational settings referred to the atmosphere, ambience, tones and climate that pervade the particular setting. In addition, the strong tradition of classroom environment research has methodologically been to conceptualize environments in terms of the perceptions of the milieu inhabitants (i.e., students and teachers) with context-specific instruments assessing particular dimensions of the learning environment (Dorman, 2008).

It has been argued that as students spend approximately 20,000 hours in classrooms by the time they graduate from a university, their relationships to their teaching-learning experiences are of considerable importance (Ching-Tse, 2013; Fraser, 2001). However, school teachers and university lecturers rarely include the classroom environment investigations in their evaluation procedures (Fraser, 2001). Furthermore, the quality of life in classrooms determines many of the things that we hope for from education – concern for community, concern for others, and commitment to the task at hand (Fraser, 2001). Therefore, teachers and educators should consider the classroom learning environment as an integral part of the teaching and learning process, and should not ignore its significance in their professional discourses.
2.3.2 Theoretical Perspectives of Learning Environment Research

Though the field of learning environment research historically originated in social sciences, the establishment of its groundwork goes back to the late 1930s in the seminal works of two pioneering psychologists, Lewin and Murray, who first analysed human environments (Martin-Dunlop & Fraser, 2008; Wahyudi, 2004). In 1936, Lewin proposed his field theory, which contended that the environment and its interaction with personal characteristics of individuals determine human behaviors (Afari, Aldridge, & Fraser, 2011). He acknowledged that any human behavior (B) can be a function of the interaction between the individual person (P) and the environment (E), which is represented by the formula, B=f(P, E). This formula became the guiding framework for research strategies in the field of learning environment.

In 1938, Murray extended Lewin’s ‘Human-Behavior Model’ by proposing a new theory called the ‘Needs-Press Model’ in order to distinguish an individual’s personal needs and environmental press (Landon, 2011). This model asserts that an individual’s need is dictated by one or more pressures from within the individual’s environment, which Murray referred to as the pressure that forces an individual to act (environmental press). In addition, he differentiated between the environmental forces perceived by an outside observer (alpha press), and those that were perceived by the individual in that environment (beta press). Hence, the concept of ‘beta press’ refers to a description of the environment as perceived by the people themselves who are in the environment. In contrast, the ‘alpha press’ is a description of the environment as observed by a detached observer, who might miss the important and relevant events and interactions. It is important for the researchers to decide on which theoretical concept, either Alpha Press or Beta Press, to base their study.
The theory was further refined by Stern, Stein and Bloom in 1956 by dividing the concept of ‘beta press’ into ‘private’ beta press and ‘consensual’ beta press (Soebari, 2012). The concept of private beta press refers to the individual student’s view of his or her classroom learning environment, whereas the consensual beta press refers to the view held by the entire class as an entity about their classrooms (Ching-Tse, 2013). These concepts help to clarify different viewpoints that can be used to study classroom learning environments and acknowledge the importance of learning environment research from different perspectives (Centre for Educational Research & Development [CERD], 2004). Thus, it must be noted that the theoretical perspectives of Beta Press underpinned many past learning environment studies (Martin-Dunlop & Fraser, 2004).

However, there is a consensus among researchers and educators that learning environment research gained its credibility within educational settings only beginning with the independent work of Walberg and Moos in the late 1960s and the early 1970s (Raaflaub & Fraser, 2002). The Learning Environment Inventory (LEI) and the Classroom Environment Scale (CES) were the first two classroom instruments that were developed during that time in the USA. The LEI, which was used to evaluate a new curriculum innovation, was devised by Walberg and Anderson in 1968, while the CES was developed by Moos and Trickett in 1974 along with several other social climate surveys for use in their work in various human environments, including psychiatric hospitals, prisons, and correctional institutions (Peer, 2011; Ching-tse, 2013).

One of the integral elements of the classroom environment theory from the early 1970s was Moos’ (1974) conceptual framework for categorizing human environment, which was significantly attributed to the seminal works of Lewin and
Murray. Lewin’s idea of environmental influences was extended to focus on the psychosocial aspects of a range of environments, including the classroom environment. This conceptual framework centred on the description of the classrooms through the perspectives of individuals in the environment, as in Murray’s ‘Needs-Press Model.’ Hence, Moos’ framework characterizes any human environment as having three broad dimensions of “relationship, personal growth, and system maintenance and change” (Dorman, 2008; Fisher & Khine, 2006). Relationship dimensions are concerned with the nature and intensity of personal relationships, such as teacher-pupil relations, communication, and teacher support (Dorman, 2008). Personal growth dimensions focus on opportunities for personal development and self-enhancement, such as investigation, participation, and encouragement (Dorman, 2008). System maintenance and system change dimensions assess the extent to which the environment is orderly, clear in expectations, able to maintain control and responsive to change (Dorman, 2008). Thus, Moos’ conceptual framework gave a boost to learning environment research, and since then many researchers have continued to conceptualize, assess and investigate the concept of learning environment based on this theoretical framework.

This was followed by the development and use of numerous research instruments for assessing the classroom learning environment (Fraser, 1998a). Examples include, the Individualised Classrooms Environment Questionnaire (ICEQ) (Fraser, 1990), Questionnaire on Teacher Interaction (QTI) (Wubbels & Levy, 1993), the Science Laboratory Environment Inventory (SLEI) (Fraser, Giddings & McRobbie, 1995), the Constructivist Learning Environment Survey (CLES) (Taylor et al., 1997), the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) (Aldridge & Fraser, 2008). The most recently
developed and commonly used learning environment instrument is the What Is Happening In this Class questionnaire (WIHIC). Thus, it is significant to note the historical perspectives of learning environment research and its development, and acknowledge those researchers’ contributions to the field of learning environment research. However, the learning environment instruments – the WIHIC and the CLES were considered useful in drawing survey scales and items for this study.

2.3.3 Past Classroom Learning Environment Research

The research in the field of classroom learning environments has received increased attention from researchers, teachers and educators during the past several decades. Classroom learning environment research has historically focused on its psychosocial dimensions – those aspects of the environment that focus on human behaviours in origin or outcome (Dorman, 2008). Many past research reviews (Dorman, 2002; Fisher & Khine, 2006; Fraser, 1998a; Khine & Fisher, 2003) have identified at least 10 areas of classroom learning environment research: associations between classroom environment and learning outcomes, evaluation of educational innovations, differences between students’ and teachers’ perceptions of classrooms, comparison of actual and preferred environments, effect on classroom environment of antecedent variables (e.g., gender, age, school type, subject, etc.), transition from primary to secondary school, school psychology, students’ meta-cognition, teacher education and educational productivity research, and the use of learning environment instruments to facilitate changes in classroom life.

Given the context, the current study focuses on one of these areas, that is, the differences between the students’ and teachers’ perceptions of classrooms, which contribute to the enhancement of theoretical knowledge of the learning environment. Fraser (2002, p. 17) reported the “strong emphasis on the use of a variety of validated
and robust questionnaires that assess students’ perceptions of their classroom environments” in the first two decades in Western countries. Many of these questionnaires assessed perceptions of either the teacher or students in terms of teacher support, participation, task orientation, innovation, cooperation and personal relevance (Fraser, Tobin & McRobbie, 2012).

Dorman (2008) noted that the focus of contemporary classroom environment research has been expanded into varied areas such as: monitoring the implementation of outcome-based learning environments in science classrooms in South Africa (Aldridge, Laugksch, Seopa, & Fraser, 2006); investigating parent and student perceptions of classroom environments (Allen & Fraser, 2007); and academic achievement and perceptions of the learning environments in virtual and traditional secondary mathematics classrooms (Hughes, McLeod, Brown, Maeda, & Choi, 2007).

There is consensus about the importance of a positive classroom learning environment among many educators, teachers and researchers who realize the significance of the learning environment research (Aldridge, Fraser, & Huang, 1999; Wang & Lin, 2009). Thus, over the past many years, though the classroom learning environment is a subtle concept, good progress has been made in conceptualizing, assessing and researching perceptions of its psychosocial characteristics at the elementary, secondary, and higher education levels (Aldridge, Fraser, Taylor, & Chen, 2000; Fisher & Khine, 2006; Fraser, 1989, 2002; Murugan, 2013; Shadrek, 2012). Research in this field has enabled educators to develop a more in-depth understanding of how students learn and the complexity of the factors that can affect the teaching and learning process (Linda & Fraser, 2010). Research showed that the
quality of the classroom environment in schools is a significant determinant of students’ learning (Dorman, 2003; Fraser, 2007).

However, investigation of associations between students’ perceptions of psychosocial characteristics of their classrooms and their cognitive and affective learning outcomes has been the strongest tradition in the previous learning environment research studies (e.g., Linda & Fraser, 2010; Majeed, Fraser, & Aldridge, 2002). According to Fraser (1994) as many as 40 past studies revealed associations between a variety of cognitive and affective outcome measures and classroom environment perceptions, results which were replicated with the use of a variety of learning environment instruments and samples ranging across numerous countries and grade levels.

Many past studies have established associations between classroom or school environment and students’ achievements and attitudes, among samples of different ages, and in different subject areas. Students’ perceptions of their classroom learning environment have been investigated in relation to variables such as leadership and school climate, class size, students’ age and gender, teachers’ gender, school type, different curricula and different instructional methods, laboratory settings, students’ academic achievements, and satisfaction with school standards (Khalil & Saar, 2009).

In a study by McRobbie and Fraser (1993), using students’ perceptions of classroom environment as predictor variables has established consistent relationships between the nature of classroom environment and student cognitive and affective outcomes. In addition, research involving a person-environment fit perspective has shown that students achieve better where there is greater congruence between the actual classroom environment and that preferred by students. The studies by Dorman,
Fraser, and McRobbie (1994), which involved the use of classroom environment scales as criterion variables in Australia, have revealed that classroom psychosocial climate varies between different types of schools. Dorman (2003) found that the quality of the classroom environment in schools can significantly determine students’ learning; that is, the students learn better when they perceive their classroom environment positively.

Research studies on comparison of students’ and teachers’ perceptions showed that, firstly, they both preferred a more positive classroom environment than they perceived as being actually present and, secondly, teachers tended to perceive the classroom environment more positively than did their students in the same classrooms (Fraser, 1994). In small-scale practical applications, the teachers have assessed their students’ perceptions of their actual and preferred classroom environment as a basis for identification and discussion of actual-preferred discrepancies, followed by a systematic attempt to improve classrooms (Fraser & Fisher, 1986).

Zandvliet and Fraser (2005) showed that students’ satisfaction with their learning and classroom independence and task orientation are related to teachers’ behaviours, instructional strategies, learning processes and learning settings. Although these factors are related to the classroom psychosocial environment, no direct association between student satisfaction and measures of the physical classroom aspects (work space and visual environments) was found. But, it must be noted that students comprise the main facet of a classroom because their perceptions of the class’s reality and their subjective interpretation of that reality constitute what determines their learning behaviour in the classroom.
Evans, Harvey, Buckley, and Yan (2009) identified three major dimensions of classroom climate as academic (pedagogical and curricular elements of the learning environment), management (discipline styles for maintaining order) and emotional (the affective interactions within the classroom). Hence, the classroom climate involves the shared perceptions of the state of the students and the teachers (Sinclair & Fraser, 2002), and it can influence students’ achievement directly through the environment set by the teacher in the classroom (Pierce, 2001). Teacher characteristics, such as dispositions toward learner-centred versus teacher-centred instruction, can shape and reflect classroom climate, and influence academic achievements (Eggen & Kauchak, 2007). Learning is found to be more effective in a classroom that is characterized by minimal levels of conflict and disruptive behaviour, smooth transitions from one activity to another, apt expressions of emotions, respectful communication and problem solving, strong interest in and focus on task, and supportiveness and receptiveness to individual differences and the needs of the students (LaParo & Pianta, 2003).

In order to create a positive classroom learning environment, efforts must be made to improve several aspects of classroom environment such as collaboration (Sinclair & Fraser, 2002), fairness (Fraser & Fisher, 2002), the relationships between classmates (Anderson, Hamilton, & Hattie, 2004) and the trust and respect between teachers and students (Buyse, Verschueren, Boumen, van Damme, & Maes, 2008). According to Khalil & Saar (2009, p. 145):

Many researchers claimed that some of the characteristics of the classroom learning environment support and stimulate positive children’s behaviours. These comprise of presenting one’s demands and expectations to the students clearly at both the educational and the behavioural levels, and persisting in the demands for an
extended period of time. A daily routine, which creates a stable and fixed environment for students, is also recommended.

Hence, the teachers must ensure that appropriate responses to situations and events that occur in class are provided and should allow their students to experience positive social and interpersonal communication. This in turn leads to increasing the students’ awareness and developing their perceptions and thus resulting in the creation and improvement of a positive classroom learning environment (Khalil & Saar, 2009).

In general, student perceptions of the learning environment have been the primary focus of learning environment research over the past many years. This is significant because student perceptions of the classroom learning environment influence learning behaviours and outcomes which in turn become part of the experienced learning environment of student-self and others (Lorschback & Jinks, 1999). In addition, each student individually brings to a setting certain beliefs about classroom roles for themselves and others, which strongly influences how an individual acts in specific situations, and also constrain the meanings of the actions of others.

2.3.4 The Validation of Learning Environment Instrument (WIHIC)

The field of learning environment research has been characterized by the development and availability of a variety of economical, valid and widely applicable research instruments (Fisher & Khine, 2006), which are available for use by the researchers. However, the instruments that were found useful in this study are the ‘Constructivist Learning Environment Survey’ (CLES) and the ‘What Is Happening In this Class’ (WIHIC), which were reviewed accordingly. This section focusses on
discussion of the use and validation of the WIHIC in past research studies in order to
indicate its robust nature in assessing the perceptions of classroom learning
environment in different contexts, with different population, subject areas, and so on.

The WIHIC questionnaire is an instrument that is widely used for assessing
students’ perceptions of their classroom environment. It is one of the most useful and
validated instruments of learning environment research, which can be ascribed to its
strong validity, reliability, and robust nature across a range of settings (Dorman,
2008). The instrument was originally developed by Fraser, Fisher and McRobbie
(1996) with 90 items (9 scales with 10 items each). It was modified by subjecting
data from 355 junior high school science students to statistical analysis, and
extensive interviewing of students about their view of their classroom environments
in general, and the wording and salience of individual items and their responses.

Finally, the WIHIC questionnaire was reduced to 56 items in seven scales
(Student Cohesiveness, Teacher Support, Involvement, Investigation, Task
Orientation, Cooperation, and Equity). It was used to assess students’ perceptions of
the classroom learning environment, which comprised seven dimensions. Each item
in the questionnaire has the five frequency response alternatives of ‘Almost never,’
’Seldom,’ ‘Sometimes,’ ‘Often,’ and Very often.’ Each of the WIHIC scales is
explained briefly in Table 2.1, and correspondingly a sample item for each scale is
also given. These scales have been used by many research practitioners and scholars
in many studies as they are or with modifications.

In different studies, all the seven scales or only some of them can be used and
the scales and items can be accordingly modified. Hence, the WIHIC questionnaire is
comprehensive, yet quite versatile in terms of meeting the needs of the user. The
WIHIC has been frequently used in several countries, especially in Asia, and it has been translated into several Asian languages and cross-validated accordingly (Fraser, 2002). Thus, the validity, reliability and usefulness of the instrument have been established through different studies in different countries, contexts, and classrooms.

Table 2.1
WIHIC scales and their description and sample items

<table>
<thead>
<tr>
<th>Scales</th>
<th>Description of Scales</th>
<th>Sample Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Cohesiveness</td>
<td>The extent to which students know, help and support one another.</td>
<td>I make friendships among students in this math class</td>
</tr>
<tr>
<td>Teacher Support</td>
<td>The extent to which teachers help, befriend, trust, and show interest in students.</td>
<td>The math teacher takes personal interest in me.</td>
</tr>
<tr>
<td>Involvement</td>
<td>The extent to which students show interest, participate in discussions, do additional work and enjoy the class.</td>
<td>I discuss and share ideas in the math class.</td>
</tr>
<tr>
<td>Investigation</td>
<td>The emphasis on the skills and processes of inquiry and their use in problem solving and investigation.</td>
<td>I am asked to think about the evidence for mathematical statements.</td>
</tr>
<tr>
<td>Task orientation</td>
<td>The extent to which it is important to complete activities planned and to stay on the subject matter.</td>
<td>Getting a certain amount of work done is important in math class.</td>
</tr>
<tr>
<td>Cooperation</td>
<td>The extent to which students cooperate rather than compete with one another on learning tasks.</td>
<td>I cooperate with other students when doing assignments in this subject.</td>
</tr>
<tr>
<td>Equity</td>
<td>The extent to which students are treated equally by the teacher and other students.</td>
<td>The teacher gives as much attention to me as to other students.</td>
</tr>
</tbody>
</table>

Sources: (Aldridge, Fraser, & Huang, 1999; Koul & Fisher, 2003; Dorman, 2008)

Various studies in classroom learning environment conducted in the past used the WIHIC questionnaire and validated it accordingly, showing that there is a strong association between learning environment and students’ outcomes. In addition, the research conducted in this field in various countries showed that the WIHIC has been consistently reliable and valid across several subject areas, at different age levels.
Chionh and Fraser (2000) used the WIHIC to investigate associations between students’ perceptions of the psychological classroom environment of geography and mathematics classes and their learning outcomes. This study revealed the positive correlation between the learning environments and the students’ achievement in examinations, attitudes and self-esteem, and the results were comparable between the two subjects in the case of each WIHIC scale. For example, self-esteem and attitudes were more favorable in classrooms that were perceived as having more teacher support, task orientation and equity.

Aldridge, Fraser and Huang (1999) used the WIHIC for a cross-cultural study (in Australia and Taiwan), which revealed that Australian students consistently perceived their classroom environments more positively than students in Taiwan, thereby indicating the cross-cultural differences in perceptions of learning environments. Similarly, Dorman (2003) used and validated the WIHIC cross-nationally, using the confirmatory factor analysis with a sample of 3,980 high school science students from Australia, the UK and Canada. The study showed the wide international applicability of the WIHIC as a valid measure of classroom psychosocial environment.

Seopa, Laugksch, Aldridge and Fraser (2003) used the WIHIC scales to examine students’ perceptions of outcome-based learning environments in science classrooms in South Africa, which also confirmed that there were statistically significant associations between students’ perceptions of learning environments and their attitudes, achievement and equity. The study showed that the differences between male and female students’ perceptions of their learning environment, attitudes, and achievement were non-significant for the actual and preferred version of the outcome-based learning environment questionnaire (OBLEQ). In a similar
study, by Margianti, Aldridge and Fraser (2002), using the WIHIC questionnaire the positive correlation between Indonesian university students’ perceptions of learning environment, attitudes and achievement was shown.

Another study by Raflaub and Fraser (2002) using the WIHIC also replicated the results of the past research (Fraser, 1998a). It revealed statistically significant associations between students’ attitudes and their perceptions of the actual and preferred classroom learning environment, as well as between gender differences and attitudes. A study of science classroom environments in India by Koul and Fisher (2003) using the WIHIC scales indicated that generally students perceived classroom environments very positively. However, socio-cultural factors seemed to play a significant role in determining the classroom environment.

Aldridge, Fraser, Fisher, Trinidad, and Wood (2003) also used the WIHIC instrument for assessing students’ perceptions of their actual and preferred classroom learning environments in outcomes-focused, technology-rich learning settings. The study revealed that the success of educational programs in promoting outcomes-focused and ICT-rich classroom learning environments have a positive correlation with students’ perceptions of their classrooms. Further, a study by Martin-Dunlop and Fraser (2004) also replicated the results of various research studies conducted in various countries over the past years showing that the WIHIC has been consistently reliable and valid across several subject areas and across different contexts. It still proves that WIHIC is an important instrument in the field of learning environment.

In addition, Opolot-Okurut (2010) reported a study of Ugandan secondary school students’ perceptions of mathematics classroom learning environment and their association with their attitudes towards mathematics. The study revealed that
the student perceptions on some of the modified WIHIC scales were statistically significant and associated with student motivation. The study suggested that teachers wishing to improve student attitudes towards mathematics in general should emphasize the classroom learning environment dimensions that are assessed by the WIHIC questionnaire.

Shadrek (2012) recently used the WIHIC questionnaire to assess Zimbabwean science students’ perceptions of their science classroom learning environment and attitudes towards science. The study confirmed that the Zimbabwean version of the modified WIHIC is a valid and reliable instrument for measuring the classroom learning environment in the Zimbabwean educational context. Similarly, Murugan (2013) employed the WIHIC in Malaysian secondary schools to assess students’ perceptions of mathematics classroom environment and mathematics achievement, which revealed the significant relationship between these two variables. Fraser (2012) listed various applications of learning environment instruments in past research – curriculum evaluation, transition to different levels of education, improvement of classroom environment, and incorporating learning environment ideas in school psychology. He argued that with such a widespread impact, the value of researching learning environment cannot be underestimated, as there are numerous possibilities for the use of learning environment instruments to improve teaching and learning processes in the classroom.

Thus, the WIHIC was considered appropriate for use in this study as it is a flexible instrument that captures the holistic view of both the teachers’ and the students’ behaviours in the classrooms. It is an instrument that has been used widely in many countries around the world. It was deemed appropriate to adapt some of the
scales of this instrument for this study as this study is also assessing perceptions of classroom learning environment in relation to the implemented new curriculum.

2.3.5 Constructivist Classroom Learning Environments

According to Fisher and Khine (2006), students’ interactions with their environment form the basis for their learning, and it is important to create a learning environment that supports constructivist views of learning. In other words, social constructivist learning environments must support communication and collaboration between peers as well as between learners and teachers, as it is through these interactions that learning takes place (Fisher & Khine, 2006). Since learning often takes place when individuals are engaged in social activities, the classroom environment must support those social activities as well as task-related activities. Reciprocal teaching, peer collaboration, cognitive apprenticeships (the process of acquiring knowledge by the use of reasoning, intuition, or perception), problem-based instruction, anchored instruction and other methods that involve learning with others, all contribute towards making a social constructivist environment (Fisher & Khine, 2006). Hence, the social constructivist view emphasizes the significance of understanding the social contexts in which students’ and teachers’ learning occurs.

According to Khalil and Saar (2009), the constructivist conception of learning and its pedagogical application go parallel with the learning environment, and the existence of reciprocal relations between teachers’ learning strategies and the learning environment influence students’ achievement. A learning environment is seen as one of the most vital factors in creating successful programs, such as the implementation of a new curriculum. Hence, high academic accomplishments are always associated with a positive classroom learning environment, which induces harmony, and a fully functional school (Khalil & Saar, 2009).
Proponents of constructivism view meaningful learning as a cognitive process in which individuals make sense of the world in relation to the knowledge which they already have constructed, and this sense-making process involves active negotiation and consensus building (Fraser, 2002). In the constructivist learning environment, learners are expected to acquire new experiences, which fit into their lives to make sense of the environment. Learning is seen as an active process wherein learners construct new ideas based on their current or past knowledge. Apart from the change in the student’s role, the teacher is also expected to change from their role of a content expert to a facilitator.

According to Rikers, van Gog and Paas (2008), “An important goal of constructivist learning environments is to engage students in deep and meaningful learning” (p.464). It is agreed upon that a few characteristics of the constructivist learning environment are essential; however, what really matter here is how these characteristics are translated into learning environments and how effective they are in terms of mediating knowledge and skills. Creating an effective constructivist learning environment for students at times is quite challenging, and things become even more difficult because there is no clear concept of what constructivist learning environments are, or what they should look like (Rikers et al., 2008). However, researchers have developed many robust instruments such as the Constructivist Learning Environment Survey (CLES) to understand such environments.

Many educational researchers have used Taylor, et al.’s (1995) framework for assessing constructivist learning environments, which have been shown to have a strong connection to student achievements and a strong influence on curriculum choices (Harrington & Enochs, 2009). Thus, “the learning process in the constructivist environment is focused on enabling students to use knowledge in many
different settings to make the learning itself as real-life as possible” (Almala, 2005, p. 10). Within the framework of a constructivist learning environment, the learners should acquire new experiences, and fit them into their lives in order to make sense of that environment (Luan, Bakar, Mee, & Ayub, 2010). Therefore, the constructivist learning environment provides students with opportunities to improve their critical and creative thinking skills as they interact and communicate with others, and solve varied problems in their mathematics classes.

The Constructivist Learning Environment Survey (CLES) as a research tool was originally developed by Taylor, Fraser and Fisher (1997) in order to assist researchers and teachers to assess the degree to which a particular classroom’s environment is consistent with a constructivist epistemology. It was also aimed to assist teachers in reflecting on their epistemological assumptions and reshaping their teaching practices. In addition, it can be used to obtain students’ perceptions about their classroom environment, and evaluate the extent to which their learning environment reflects constructivist principles (Cetin-Dindar et al., 2014). It was further argued that the constructivist learning environments are important in students’ learning and for stimulating their critical and creative thinking skills (Kwan & Wong, 2014).

The CLES consisted of 36 items, with five frequency response alternatives ranging from Almost Never, to Almost Always, which assess either students’ or teachers’ perceptions of Personal Relevance, Uncertainty, Critical Voice, Shared Control, and Student Negotiation. Table 2.2 below provides the description of the five scales of the CLES, which were used in numerous studies by educational researchers (Harrington & Enochs, 2009).
Table 2.2

Description of Constructivist Learning Environment Survey (CLES) Scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description of Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Relevance</td>
<td>The extent to which mathematics is connected to students’ real life experiences outside the schools.</td>
</tr>
<tr>
<td>Student Negotiation</td>
<td>The extent to which students can explain and justify to other students their newly developing mathematical ideas, and to reflect self-critically on the viability of their own ideas.</td>
</tr>
<tr>
<td>Shared Control</td>
<td>The extent to which students control along with the teacher, the learning environment in terms of learning goals, design and management of learning activities and assessment criteria.</td>
</tr>
<tr>
<td>Critical Voice</td>
<td>The extent to which students feel legitimate and beneficial to question the teachers’ instructional plans and methods, and express concerns about any impediments to their learning.</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>The extent to which students have opportunities to experience subject knowledge as arising from theory-dependent inquiry, involving human experiences and values, evolving and non-foundational, and culturally and socially determined.</td>
</tr>
</tbody>
</table>

Source: (Harrington & Enochs, 2009, p.49)

The CLES has been used and validated in a number of past studies in many countries. In South African contexts, Aldridge, Fraser & Sebela (2004) adapted and used it with 1864 intermediate and senior-level learners in 43 classes in six schools. The a priori factor structure was confirmed for the CLES, which includes 24 items in the actual or preferred form with six in each of the four scales of Personal Relevance, Uncertainty, Shared Control and Student Negotiation. The study revealed students’ preferences for a more student-centered learning environment and the CLES was found useful for providing feedback that can guide teachers in orienting their classrooms towards more constructivist approaches to teaching and learning of mathematics.
Aldridge, Fraser, Taylor and Chen (2000) conducted a cross-national study using the CLES with 1081 students from 50 classes in Australia and 1879 students from 50 classes in Taiwan. It was found that each scale’s internal consistency reliability, factor structure and ability to differentiate between classrooms could reveal interesting differences between Taiwan and Australia on average scale scores.

Peiro and Fraser (2009) used a modified version of the CLES translating it into Spanish, with 739 grade K – 3 science students both in English and Spanish versions in Miami, USA. Statistical analyses supported the validity of the CLES within the context of the study, which revealed strong and positive associations between students’ attitudes and the nature of the classroom learning environment. Murugan (2013) employed the CLES in combination with the WIHIC in Malaysian secondary school contexts and investigated students’ perceptions of the mathematics classroom environment and mathematics achievement. The study revealed a significant difference in the perception of the mathematics classroom learning environment based on gender, and weak correlation was observed in between the learning environment and mathematics achievement.

The CLES also proved to be one of the most validated instruments in the field of learning environment research, and was used extensively in many past studies. Hence, the current study also adapted some of its scales in order to assess whether the constructivist ideas of teaching and learning of mathematics are present in Bhutanese mathematics classrooms.

Thus, the current study adapted the combination of eight scales (Teacher Support, Student Cohesiveness, Task Orientation, Cooperation, Equity, Critical Voice, Personal Relevance and Student Negotiation) from the WIHIC and the CLES,
which are the most validated and widely used instruments in the field of learning environment research. Since Bhutan has its own unique cultural and social contexts, the use of these two instruments in Bhutanese schools may not necessarily guarantee the best of the findings in this study. Besides, Bhutanese mathematics classroom environments are also quite distinct, determined by different contextual factors, the instruments’ wide applicability and their robust nature may not always be true in this context. However, the main advantage in using these instruments in the study is that it provides the foundation for classroom learning environment research in the Bhutanese school context.

2.4 Curriculum Reform and Change

This section presents an overview of the concept of curriculum change and reform in mathematics education in general, the concept of standards-based mathematics curriculum, the characteristics of standards-based curriculum, and key elements of the implementation of the standards-based curriculum. It also finally provides a review of the new Bhutanese school mathematics curriculum, and its implications on the mathematics classroom environments.

2.4.1 The Concept of Curriculum Reform and Change

According to Cai and Ni (2011), a curriculum is a means to inform ideas, and a mechanism for making the reform ideas a reality by enabling teachers to learn mathematics as well as how to teach it. Hence, the curriculum not only informs what mathematics students should learn (content), but also how mathematics should be taught (approaches). Marsh (2004) noted that a curriculum starts as a plan and it becomes a reality only when teachers implement it with real students in real classrooms. Although careful planning and development of a curriculum are
critically important, they do not make sense unless teachers are aware of the curriculum and have the skills to implement it in their classrooms (Marsh, 2004).

The term ‘curriculum implementation’ refers to the actual use of a curriculum or a syllabus, which forms a critical phase in the cycle of planning and teaching a curriculum (Marsh, 2004). It is important to make the processes and discourses of curriculum change transparent so that teachers can have a framework for the implementation of a curriculum document into their classroom practices (Fernandez et al., 2008). This is because without proper planning it would be difficult for the teachers to participate in the negotiation of curriculum meanings, and the implementation would take place in unanticipated ways.

It has been found useful to employ classroom climate dimensions as criteria to evaluate the effectiveness of curriculum, because these dimensions have differentiated revealingly between alternative curricula in cases where student outcome measures have shown little sensitivity (Marsh, 2004). Yan and Kember (2003, p. 285) maintained that “what happens in a classroom is influenced by the factors such as the curriculum, the type of teaching approaches, the way a teacher relates to a class and the nature of assigned study tasks.”

According to Handal and Herrington (2003), the pace of curriculum reform is critically determined by teachers’ beliefs about the teaching and learning of mathematics. The curriculum change would be more likely to be successful when its goals match with the teachers’ practices, which depend on their beliefs. It was maintained that policy-makers and administrators should not take for granted that the process of curriculum implementation translates directly into classroom reality, because teachers ultimately decide the fate of any educational program, as it is in their hands to make it a success or a failure (Handal & Herrington, 2003). Thus, “the
current trends in mathematics education towards constructivist learning environments and assessment of learning based on tangible outcomes will only succeed if teachers’ beliefs about these reforms are considered and confronted” (Handal & Herrington, 2003, p. 68). It was noted that unless curriculum developers take account of teachers’ beliefs and acknowledge the sociocultural factors that influence those beliefs in designing and planning new curricula, these curriculum materials are unlikely to be implemented according to the intended plan (Mansour, 2010). In addition, it was pointed out that curriculum changes probably work best when curriculum developers acknowledge existing realities, classroom cultures and implementation requirements (Chisholm & Leyendecker, 2008). This means understanding and sharing the meaning of the educational change, providing for adaptations to cultural circumstances and local context, and capacity building throughout the system are required (Chisholm & Leyendecker, 2008).

Mathematics education, in its essence has the responsibility for nurturing students’ creativity and critical thinking skills for their life-long learning. The curriculum change can be used as an effective way to change classroom practices and influence student learning to meet the needs of the ever-changing world (Cai & Ni, 2011). Hence, advocates of mathematics education reform typically have tried to bring change in classroom practices, and students’ learning by means of curriculum changes. According to Manouchehri and Goodman (1998) the recommendations for reform in mathematics education uniformly call for an increased emphasis on meaningful experiences in mathematics and a decreased emphasis on the repeated practice of computational algorithms. Thus, current visions for teaching mathematics include acknowledging the teacher as the ‘facilitator of knowledge and orchestrator’ of conducive learning environments (Manouchehri & Goodman, 1998). Hence, the
effectiveness of classroom learning environment largely depends upon the way the curriculum is defined, planned and developed in an education system.

### 2.4.2 Standards-based Mathematics Curriculum

The standards-based mathematics curriculum has its origin in the United States of America. It was initiated by the National Council for Teachers of Mathematics (NCTM), which released the first Standards document in 1989, followed by a revised document in 2000. The revision, Principles and Standards in School Mathematics, emphasizes the development of conceptual understanding and reasoning. This led to a shift in focus of mathematics education from direct instruction, drill and practice towards more active student engagement with mathematical ideas through collaborative investigations, hands-on explorations, the use of multiple representations, and discussion and writing (Goldsmith & Mark, 1999). In the latter approach, students are actively involved in building their own mathematical understanding, which helps them gain a deeper understanding of mathematical concepts. Many new approaches to secondary school mathematics in many countries are based on principles similar to the NCTM Standards. Bay, Beem, Reys, Papick and Barnes (1999) maintained that several contextual factors contribute to the effectiveness of teachers in implementing a standards-based mathematics curriculum in their classrooms. Awareness of these factors and the development of ways to address them will increase the likelihood of success in implementing the curriculum.

According to Moseley and Brenner (2009, p. 2), empirical studies in mathematics education have reported benefits of standards-based curricula in facilitating students’ capacity to solve novel problems when compared to traditional direct instruction approaches. These benefits are attributed to teachers’ pedagogical beliefs in the constructivist principles that underlie standards-based curricula, or
teachers’ use of multiple representations as a defining element of teaching practice (Moseley & Brenner, 2009). In addition, a standards-based approach in mathematics also involves using story problems to allow students to explore a solution. The emphasis in this approach is an understanding of concepts and processes, assuming mastery of basic computation skills (Brucker, 2009).

2.4.3 Characteristics of Standards-based Curriculum

Trafton, Reys and Wasman (2001) describe the following six central characteristics of standards-based mathematics curriculum materials, that help students learn important mathematics.

*Focus on core mathematics for all students.* This refers to the incorporation of a range of important mathematics, general literacy goals for school mathematics, and as a foundation for advanced study of the subject. Five content standards for preschool through 12th grade mathematics are: 1) number and operations, 2) algebra, 3) geometry, 4) measurement, and 5) data analysis and probability. The five fundamental mathematical processes that students should learn and use along with the mathematics contents are: problem solving, reasoning and proof, communication, connections, and representation. These processes are basically guided by five NCTM principles for teaching mathematics: technology, assessment, curriculum, teaching and learning.

*Coherence.* This refers to the presentation of mathematics so that the core ideas of the subject are highlighted and cause students to see it as an integrated whole. Standards-based curriculum materials lead to promotion of coherence in learning mathematics through initially focusing on big ideas, and then emphasizing connections and links to related mathematical ideas and applications (Trafton et al., 2001). It is believed that focusing on individual pieces and rules does not promote
coherence in mathematics learning, but learning that is connected as a coherent whole result in higher achievements, greater capability, and less susceptibility to forgetting.

**Developing in-depth ideas.** This refers to the increased sophistication in the way mathematical ideas are treated, along with the coherent development of these mathematical ideas, which helps students toward a deeper understanding (Trafton et al., 2001). It is maintained that in-depth learning is more likely to occur when the curriculum concentrates on a few big ideas and their interconnections and when teachers design instruction to engage students deeply with these ideas.

**Promoting sense-making.** This means helping students make sense of mathematics, which can be promoted by spending substantial time on the fundamental ideas of a mathematical domain such as rational numbers. This is because having time to ‘think things through’ helps students make connection between their everyday, informal knowledge and their new knowledge. Promoting sense-making can also occur when students are allowed to create and use their own ways of thinking to solve problems and having them share their thinking with other students and the teacher. However, students’ sense-making ability in the classroom depends on the teacher’s expertise in selecting good tasks, engaging students in thoughtful reflection, and creating a classroom environment that supports reflection and communication (Trafton et al., 2001).

**Engaging students physically and intellectually through problems and tasks.** Standards-based curriculum helps in engaging students both physically and mentally through problems and tasks. Engagement here can involve hands-on-tasks, but its purpose goes far beyond ‘making math fun’ (Trafton et al., 2001). It involves careful selection of tasks to draw students into the study of mathematics by directing and
focusing their thinking on important mathematics, thereby emphasizing intellectual engagement. Physical engagement is also an important aspect of the development of mathematical ideas. So, many tasks incorporate manipulative materials as tools to help students engage in and explore mathematics, as these manipulatives provide concrete representation of ideas or models, and help them understand the mathematical problems.

Motivation of learning mathematics. In order to contextualize mathematical study, an emphasis on its application is an important characteristic of standards-based materials, which motivates students to learn. The applications have become part of understanding mathematics and they provide ways to interpret it. Thus, establishing a strong and substantive relationship between mathematics and its widespread uses is more urgent than ever. As a result, applications of standards-based mathematics curriculum are being woven into instructional materials in powerful new ways, so that learners enjoy learning mathematics (Trafton et al., 2001).

2.4.4 Implementation of Standards-based Curriculum

Bay, Reys and Reys (1999) acknowledged the difficulty in the curriculum transition process, because particularly for teachers, making a major curriculum change means facing new types of problems, altered teaching methods, different forms of assessment, and increased questions from parents. They identified and examined the ten critical elements that must be in place for the effective implementation of a standards-based curriculum. These are discussed as follows:

(i) Administrative support. It was found that significant curriculum change in mathematics is enhanced by the leadership and support of administrators.

Support from administration includes activities such as proper training and
workshops for teachers, visits to other schools that have implemented standards-based curriculum, and inviting resource persons or experts to schools to discuss the new curriculum.

(ii) *Opportunities to study curriculum materials properly.* Teachers as curriculum implementers need time to familiarize themselves with the new curriculum materials. Particularly helpful for teachers training sessions on each specific curriculum component, whereby they engage themselves in student activities that help them learn about the new curriculum and alternative classroom practices.

(iii) *Sampling the Curriculum.* Teachers really need to try out the new curriculum materials part by part, which will allow them to experiment with standards-based reform. Though time-consuming, trying these materials is a vital step in helping each teacher become familiar with the content and approach to instruction recommended by the curriculum developers.

(iv) *Daily Planning.* Once teachers decide to pilot or to fully adopt a particular curriculum project they face other demands. They have to determine where to spend more time, what to skip, and what students could do at home, etc. Providing time for teachers to plan together for the first year of implementation would help teachers meet the challenges associated with implementing a new curriculum.

(v) *Interaction with Experts.* Teachers need to hear from experts like national leaders, authors of a given curriculum, teachers experienced in using a curriculum, and others. There should be opportunities for teachers to observe experts using a standards-based curriculum in the classroom and interact with
them, which would be beneficial and allow them to see the instructional methods and questioning techniques expert teachers used.

(vi) **Collaboration with Colleagues.** There is a need for teachers to be able to meet with one another, that is, to plan lessons together, share stories, and discuss more global issues. Collaboration really seems critical to teachers because they need to share units which others are using, observe how they pace activities and units, how they manage their classroom, and how they handle grading.

(vii) **Incorporating New Assessments.** There are many new assessment techniques and tools to employ to gauge students’ learning. For this, once again training is important and necessary, and it must provide teachers with suggestions and remedies so that they do not spend hours on assessment techniques.

(viii) **Communicating with Parents.** Communicating with parents about the new program is significant; it helps them to see that mathematics is much more than formulas and procedures. Further, it is important to share the positive outcomes of such interaction (Bay-Williams & Meyer, 2003).

(ix) **Helping Students Adjust.** In the process of implementing innovation such as a new curriculum, it takes time for students to realize that this standards-based mathematics curriculum includes a great deal of mathematics in addition to computation. Hence, students need guidance and support to help them adjust to the new curriculum in terms of teaching-learning process, and assessment procedures. In regard to case of Bhutanese students, the new curriculum was introduced in between the grade levels in whichever the grades they were, and it seems no proper adjustment was considered.
Planning for Transition. There should be proper planning for a smooth transition from one level to another. It would be helpful to meet students to discuss plans for articulation across the grades.

Thus, supporting the implementation of a standards-based mathematics curriculum is crucial, and these ten elements provide a useful framework of what is involved in supporting the curriculum change at any level. The initial implementation and notion of change is always difficult for teachers and students; however, if administration and teachers could carefully research, plan, develop ongoing professional development opportunities, and prepare for transition, students would develop a deeper and richer kind of mathematical learning experiences (Bay, Reys, & Reys, 1999).

There is considerable support for reform in traditional mathematics classes because the standards-based mathematics pushes students to think and discover how to solve problems by themselves (Bay, Reys, & Reys, 1999). However, a more supportive learning environment is needed to allow students to develop both skills and conceptual depth, and the curriculum must enable students to make sense of mathematics and to recognize and value the power of their own mathematical thinking. Smeal (2008) argued that the National Council of Teachers of Mathematics has challenged all mathematics teachers to use the Standards document as guidelines for teaching mathematics. Many pre-service and school programs in many countries in the world are now presenting curricula that are based on these standards documents. Similarly, Bhutanese school and teacher education programs have also adopted those standards as guidelines for the development of their curricula. However, the concern here is how mathematics teachers adopt teaching methods that are reflective of the guidelines of the standards that they encountered in their pre-
service education. This is because the classroom realisation of curriculum reform comes about through the actions of individual teachers, and it is their beliefs, practices, and working environment that shape and direct implementation (Christou, Eliophotou-Menon, & Philippou, 2004).

According to Cox (2009), the curriculum changes should reflect the culmination of an alignment between standards, curriculum, assessments and instruction that exemplifies the shift to standards-based accountability towards systemic reform efforts. Hence, there is a need for mathematics reform at every level, and NCTM emphasizes the need to change teaching and learning of mathematics and advocates the implementation of standards-based instructions into mathematics classrooms (Curtis, 2006). This brings change in the learning environment, impacting on students' perceptions of being a student of mathematics in terms of confidence, anxiety, enjoyment, and motivation, and the relevance of mathematics in personal and professional experiences (Curtis, 2006). In the same vein, the current study also aimed to report on the change in Bhutanese 8th grade mathematics classrooms through students' and teachers’ perspectives, which can reflect the impact of the new mathematics curriculum on it.

2.5 New Bhutanese Mathematics Curriculum and Its Implications on Classrooms

There was a change in thinking about the curriculum and teaching methods used in the Bhutanese mathematics classrooms among educators, and even at the government level. According to the Kuensel Corporation of Bhutan [KCB] (2006):

The education ministry is changing the approach to teaching mathematics to improve the quality of mathematics in Bhutanese schools. The new teaching methods will be introduced in class XI and in the middle and lower secondary levels over the next
four or five years. In the lower levels like class PP, I, and II, mathematics will be taught using manipulative objects.

Thus, the Ministry of Education (MoE) in Bhutan initiated a major curriculum reform in mathematics for all grades from preprimary through year 12, aiming to enhance the quality of mathematics education (Policy & Planning Division[PPD], 2006). This reform was mainly aimed at making mathematics education relevant and adaptive to the changing time and needs of Bhutanese society. Moreover, it was expected to reflect research from around the world that helps students to understand the beauty of mathematics as well as its utility in their lives (Curriculum & Profesional Support Division [CAPSD], 2005). It was argued that it is very important to align a curriculum with the needs of the learners and the nation at large, considering different factors such as economic, political, social, cultural, and moral (Parkay, Anctil & Hass, 2006).

The new Bhutanese school mathematics curriculum is based on the principles and standards set by the National Council of Teachers of Mathematics (NCTM), a professional body based in the USA. The NCTM standards are considered ‘gold standards’ in mathematics education. Their implementation demands a shift in the approach to teaching and learning mathematics, and changes in the concept of classroom learning environments. Hence, “methodologies based on a social constructivist approach, including assessment practices which reflect international best practices, are incorporated within the mathematics textbooks” (Curriculum & Profesional Support Division [CAPSD], 2008a, p. x). In order to have a meaningful teaching and learning process, the mathematics curriculum needs to be appropriately designed, taking into consideration the logical and sequential development of mathematical concepts and skills.
The current study provides an avenue for reviewing the new Bhutanese school mathematics curriculum based on Tyler’s (1949) four elements of the curriculum planning: objectives; content organization; pedagogy; and evaluation. Each of these four elements can be discussed and analyzed in line with the outline given in Figure 2.4.

![Diagram of Curriculum with Objectives, Content, Pedagogy, and Assessment]

**Figure 2.4 Outline for the review of new mathematics curriculum**

The aims and objectives of the new mathematics curriculum encompass three domains of learning: cognitive, affective and psychomotor, which are labelled as “knowledge and skills, processes and methods, and affective demeanor and values” (Ni, Li, Li, & Zhang, 2011, p. 102). Hence, Bhutanese students should aim at (1) acquiring important mathematical knowledge and basic problem-solving skills that are required for their life-long learning; (2) applying their mathematical knowledge and skills to observe, analyze, and solve problems in daily life, and (3) appreciating and connecting mathematics to the nature and society (Curriculum & Professional Support Division [CAPSD], 2005; Ni et al., 2011). It also aims at providing opportunities and believing in learners’ ability to understand and contribute to the
advancement of science and technology within Bhutanese culture, history and tradition (Curriculum & Professional Support Division [CAPSD], 2005). In addition, the objectives include expectations for more advanced interpersonal skills, communication skills, reasoning, problem solving, and decision making which mathematics aims to address (Curriculum & Professional Support Division [CAPSD], 2008a).

In regard to subject content, the new curriculum delineates seven core areas: Numbers, Operations, Patterns & Relations, Measurement, Algebra, Geometry, and Probability & Data Management (Curriculum & Professional Support Division [CAPSD], 2008a). All these topics were included in the new curriculum for all class levels from preprimary through to year 12, but in the old curriculum, the seventh area was excluded in preprimary to eighth grade. The content of new curriculum is well organized both vertically and horizontally. Horizontal organization refers to the breadth and depth of the curriculum at a given time, and the relationship between concepts, skills, and values that are mutually parallel among different subjects taught in a class level (Sowell, 2000). Vertical organization of a curriculum ensures that ideas, themes, and skills are dealt with more than once in school curricula (Sowell, 2000), because students do not learn at an instant. It also refers not only to the recurrence and repetition of content, but also to its depth and breadth, and each successive experience with a skill or concept should build on the preceding ones, and the new experiences should be broader and deeper than the earlier experiences. In terms of content organization, the new curriculum is much better than the old curriculum, but its horizontal organization in terms of integration seems precarious as there seems no much link between the concepts and skills which are dealt in it and other subject areas.
In terms of **pedagogy**, the new curriculum envisages a shift from traditional to constructivist approach to teaching of mathematics, which is based on five process standards (problem-solving, reasoning and proof, communication, connections and representations). This approach facilitates the processes of knowledge construction and its application, motivating students to engage in collecting and processing of information, analyzing and solving problems, and communicating and cooperating with others (Ni et al., 2011). The process of classroom instruction is further guided by five principles for teaching mathematics which includes equity, curriculum, teaching, learning, assessment, and technology (NCTM, 2000). The details for teaching-learning process for each topic are provided in the teacher’s guide for each class level, which also characterizes the new curriculum as distinct from the old curriculum.

In terms of **assessment**, the new curriculum standards recommend to use the process-oriented assessments rather than product-based assessments in mathematics classrooms. Ni, Li, Li, and Zhang (2011) termed it as student assessments which are based on student competence, process-orientation, and student learning and development-orientation. It suggests various forms of assessment like checking to see how mathematics learning takes place and collect information about children’s understanding of mathematics, which is used as both formative and summative tools. Teacher’s guide also suggest assessments such as tests, assignments, projects, performance tasks, exams, interviews, observations, and home works (Curriculum & Professional Support Division [CAPSD], 2008a). Self and peer assessments can also provide students opportunities to become independent and reflective learners (Ni et al., 2011). Such formative assessments not only help students to assess their learning
and abilities, but also to make assessments themselves as opportunities for students to learn and grow mathematically and personally.

Thus, the new curriculum, bounded by politico-economic and sociocultural elements of Bhutan as a nation and guided by the NCTM model, theoretically seems to lean towards social constructionism, while, practically it bounds to progressivist philosophy. Progressivism directs towards child-centered curriculum but it does not promote democratic learning and problem solving skills in mathematics classes (Parkay, Anctil, & Hass, 2006). From ‘progressivist’ perspective, teachers do not have liberty to teach based on what students want to learn but rather focus largely on what students need to learn. It also does not allow a provision for social change, though it believes in principle of ‘learning by doing.’

Overall, the new mathematics curriculum is well organized and planned, since it incorporates all required elements of curriculum design, and embraces relevant ideas from all philosophical, social, psychological and humanistic perspectives. It also contains required values and societal needs for Bhutanese children, because every chapter focusses on the value-laden issues and social norms that would prepare learners towards facing the challenges of this fast changing world in the near future.

2.5.2 Implications of Curriculum Change on Mathematics Classrooms

The new mathematics curriculum is in accordance with the principles of Gross National Happiness (GNH), the national development philosophy of Bhutan. Most of the learning activities are child-centered and result in collaborative and inclusive learning, which contributes to a positive learning atmosphere. For instance, almost all the learning activities under each unit and chapter require the teachers to work
collaboratively with children, which results in creating a conducive and child-friendly atmosphere within the classroom contexts. This enables teachers and students to develop a sense of unity and inclusiveness that generates happiness in both teachers and students. Thus, the new curriculum suggests a way forward to bring change to the classroom environment to include more pair work and group work with an increased emphasis on communication (Curriculum & Professional Support Division [CAPSD], 2005). Hence, it provides new directions in creating a positive learning environment in mathematics classrooms, which should reflect constructivist views of learning mathematics.

For the intentions of the curriculum to be fully realized, there has to be a paradigmatic shift in the concept of learning environment in mathematics from a traditionalist to a constructivist approach. More importantly, the change in the concept of classroom environment must be understood by educational leaders, system administrators, and classroom teachers. This is because the classroom environment in the process of teaching and learning new mathematics requires strong support from the educational leaders and system administrators in order to make learning meaningful for the learners. It must be noted that the effective implementation of curriculum is simply not possible without the strong administrative support and dynamic leadership roles in schools.

The new curriculum instruction also requires the teachers to move from traditional to new constructivist practices, and change their beliefs about teaching mathematics. It provides a new direction in terms of teaching strategies and instructional organization, but teachers can always go beyond what is given in the teachers’ guides and use their own creativity and critical thinking in order to make
mathematics learning more meaningful to their learners (Curriculum & Profesional Support Division [CAPSD], 2008a).

The curriculum documents indicate that the classroom environment has a lot to do with students’ social skills and their learning. The idea is that through classroom community, the students learn the importance of pair and group work, and how they should support each other in their tasks. Hence, the students learn that they should value group and a climate of mutual support in accordance with their own culture and traditions. This means that they are encouraged to understand mathematical concepts and ideas using various approaches and means rather than just memorizing mathematical formulae, rules and principles that are meaningless in their lives.

The change in classroom learning environment within the framework of the new curriculum was mainly intended to improve various mathematical skills for students by teaching various objectives in the mathematics syllabus. Students at the end of their secondary schooling are expected to have mastered mathematical skills such as problem-solving, estimating, communicating, interpreting data, reasoning and proofs, thereby ultimately leading to a mathematically competent society.

However, there has been frequently a mismatch between the curriculum intended, the implemented and the implemented or attained curriculum in any education system (Handal & Herrington, 2003), which can be attributed to many contextual factors, such as the general philosophy of reform movement, leadership and management at the schools, the availability of resources in the schools, and so on. This study also intended to examine contextual factors, which are unique to Bhutanese school contexts and which significantly determine the effectiveness of classroom environments.
2.6 The Research Conceptual Framework

The theory of social constructivism as the basis of the standards-based mathematics curriculum provides a valuable framework to understand the classroom learning environment with its various dimensions and contextual factors within the classroom. A pedagogical shift from a traditional to a constructivist teaching approach, which values collaboration and interactions in the classroom more than individualism (Dhindsa, 2005), might be appropriate for adoption in Bhutanese school contexts. A social constructivist approach to learning mathematics would help the students and teachers to use those cooperative and collaborative values drawn from the international research, and from Bhutanese sociocultural contexts for the effective teaching and learning of mathematics.

The new mathematics curriculum is expected to bring change in student learning outcomes in mathematics in terms of relevancy and depth of understanding of mathematical concepts, making learning more meaningful to the learners. However, the constructivist classroom practices and the changes in the mathematics teaching and learning process under the framework of the new mathematics curriculum can only be understood through students’ and teachers’ perceptions of their classroom learning environments. Therefore, the current study investigated their perceptions of classroom learning environment in reference to the new curriculum implementation.

Based on various principles, standards and goals set in the new mathematics curriculum, the study focused on various dimensions of the classroom learning environment instruments from the past research studies. However, as discussed earlier, Moos’ (1974) conceptual framework, which categorizes human environments as having relationship, personal growth, and system maintenance and change
dimensions (Dorman, 2008), has been adopted. Relationship dimensions are concerned with the nature and intensity of personal relationships; personal growth dimensions focus on opportunities for personal development and self-enhancement; and system change dimensions are concerned with the extent to which the environment is orderly, clear in expectations, maintains control and is responsive to change (Dorman, 2008).

These three conceptual dimensions of human environment were instrumental in leading the way for much of the past research into classroom learning environments (Landon, 2011). In the same vein, these dimensions were significant from the perspective of the current study, as they were used as a measure of the perceptions of learning environment in Bhutanese eighth grade mathematics classrooms. Thus, the review of literature and theories help to situate the study within the theoretical framework of the classroom learning environment and the curriculum reform in mathematics, which led to conceptualization of a simple research framework for the study. In other words, this framework provides a kind of summary of literature and theories discussed above and how they underpin the current study.

Figure 2.5 illustrates the conceptual framework for the study, associating the two broad concepts of the classroom learning environment, and the mathematics curriculum in Bhutanese secondary schools. It provides an overview of the big ideas about the current study, along with its significance related to the national goal of Bhutan, that is, GNH. In addition, it also provides a comprehensive view of conceptual links among three dimensions of classroom environment and eight MCLES scales used in the study.
The ideal of the philosophy of Gross National Happiness as the long-term national goal for Bhutan is seen as a unique standard for evaluating the success of development in the country (Powdyel, 2005). Hence, the researcher believes that particularly students’ positive perceptions of their classroom environment can be associated with their happiness and satisfaction in the classrooms. Research shows that students’ positive perceptions of their classroom environment have been closely associated with their achievements and learning outcomes (Dorman, 2008; Fraser,
It is the known facts that when the students are able to achieve better learning outcomes and better results, the happier they are, and vice-versa. Bates (2009) agreed with the modern view that the state should strive to promote conditions that will promote happiness of citizens, a view based on the common value judgment that ‘what promotes human happiness is good and what promotes human misery is evil.’ Hence, good student learning outcomes lead to better overall educational achievements, which can contribute to human happiness in general as a nation.

The current study sought to provide an understanding of the nature of classroom learning environment in the context of Bhutanese schools in terms of students’ and teachers’ perceptions in relation to the newly implemented mathematics curriculum. As discussed above, perceptions of human environments can be understood through the three dimensions of relationships, personal growth, and system change and maintenance, conceptualised as the Moos’ (1974) Scheme (Dorman, 2008). Each of these three dimensions can be further examined through various sub-dimensions (scales) such as teacher support, student cohesiveness, task orientation, cooperation, equity, critical voice, personal relevance, student negotiation, and so on.

The study used MCLES as the instrument to assess teachers and students’ perceptions of each of these scales. Perceptions of each of these scales were measured in terms of three background variables – gender, school level, and school location. However, there are contextual factors that influence the classroom learning environment as well as the curriculum implementation process. Thus, the current study in terms of this conceptual framework has practical as well as theoretical
significance, contributing and adding values to the field of learning environment research.

The above research conceptual framework can also be explained in a slightly different manner, bringing in the ‘embedded relationship’ between the curriculum and the classroom learning environment. The embedded relationship between the two variables can be explained as closely in-built, and really inseparable from one another. However, though they are interrelated to one another, and it is difficult to explain one without the other, many teachers and educators often tend to distinguish them as different entities. Figure 2.6 illustrates the relationship between the new curriculum and the classroom learning environment.

From the Bhutanese perspective, curriculum and classroom learning environment both have the ultimate aim of achieving the national goal of Gross National Happiness (GNH). Education is one of the GNH domains (Ura, 2008) that will bring happiness to individual persons, students and teachers, and thereby contribute to the GNH at the macro level. Curriculum is the key element of education (Centre for Educational Research & Development [CERD], 2004), and it is the means to achieve educational goals. The curriculum in this model is considered from the perspective of its intentions towards the student, the teacher and the classroom. In other words, what has been intended in the new curriculum in regard to the teacher, the student, and the classroom, within which the learning takes place. Hence, the curriculum tends to act as the means of interactions between the students and the teachers within the given classroom contexts.

On the other hand, the model presents the theoretical basis of the classroom learning environment, which is provided by Moos’ (1974) scheme, which classifies human environment into three dimensions: relationship dimension, personal growth
dimension and system change dimension (as explained earlier). This model aims to provide an alternative explanation of the conceptual framework of the study.

![A Model of Curriculum-Classroom Environment Relationship](image)

**Figure 2.6 A Model of Curriculum-Classroom Environment Relationship**

Notes:  
TS: Teacher Support; PR: Personal Relevance; SC: Student Cohesiveness; CO: Cooperation; TO: Task Orientation; CV: Critical Voice; SN: Student Negotiation; EQ: Equity; CLE: Classroom Learning Environment; GNH: Gross National Happiness

Any human environment can be expected to have these three components, which are crucial for the individual participants as well as the system as a whole. Each of these dimensions can be divided into various smaller dimensions, which known as scales. These are used as the scales or constructs of the Mathematics Classroom Learning Environment Survey (MCLES) as shown in Table 2.3 below. The study adapted these scales from two existing classroom learning environment instruments – the WIHIC (Aldridge, Fraser, & Huang, 1999) and the CLES (Taylor et al., 1997).
Table 2.3

Three Psychosocial Dimensions with Respective Scales used in the MCLES

<table>
<thead>
<tr>
<th>Psychosocial Dimensions</th>
<th>Scales used in MCLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Relationship Dimension</td>
<td>Teacher Support (TS)</td>
</tr>
<tr>
<td></td>
<td>Personal Relevance (PR)</td>
</tr>
<tr>
<td></td>
<td>Student Cohesiveness (SC)</td>
</tr>
<tr>
<td>2. Personal Growth Dimension</td>
<td>Cooperation (CO)</td>
</tr>
<tr>
<td></td>
<td>Task Orientation (TO)</td>
</tr>
<tr>
<td></td>
<td>Critical Voice (CV)</td>
</tr>
<tr>
<td>3. System Change</td>
<td>Equity (EQ)</td>
</tr>
<tr>
<td></td>
<td>Student Negotiation (SN)</td>
</tr>
</tbody>
</table>

The curriculum and the classroom learning environment both influence the way in which students behave in class, their approach to study tasks, the nature of teacher-student and student-student relationships, and students’ academic self-concept (Yan & Kember, 2003). Thus, it is very important to understand the theoretical relationship between the curriculum and the classroom learning environment, which tend to influence one another and are geared towards student learning.

2.7 Chapter Summary

The chapter reviewed the relevant literature for the present study. The chapter began by examining the theoretical perspectives of social constructivism encompassing the constructivist views of the nature of mathematics, the constructivist view of teaching and learning mathematics, and sociocultural perspectives of learning mathematics. The literature on the field of learning environment mainly delved into the concepts of classroom learning environment, providing historical and theoretical perspectives of classroom environment research, which provided the conceptual frameworks for the study. It also highlighted the past research in classroom learning environment and
two major learning environment instruments that are relevant for the purpose of the current study.

The discussion then highlighted curriculum reform and change, along with the concepts of standards-based mathematics curriculum, its six critical characteristics, and ten elements for its implementation, and touching on to curriculum change and its implications for the classroom learning environment. This aimed to provide the basis for how the curricular change affects the classroom learning environment. The chapter concluded with drawing of the conceptual framework for the study from both the relevant literature and theories together.
Chapter 3: Research Methodology

3.1 An Overview

This chapter presents the design and methodology employed to achieve the aims and objectives of the research study. The chapter is divided into the following eight sections.

- Section 3.2 discusses the research paradigm, which provides the theoretical underpinnings for the methodology, research design and methods adopted;
- Section 3.3 describes the research settings and details the samples used in the study;
- Section 3.4 highlights the instruments used in the study and justifies their use;
- Section 3.5 outlines the procedure used and the timeline for completion of each stage of the study;
- Section 3.6 discusses how the quantitative and qualitative data were analyzed;
- Section 3.7 highlights the research quality standards;
- Section 3.8 delves into the ethical considerations of the research and its potential problems and limitations; and finally,
- Section 3.9 provides the chapter summary.

This current study adopted a sequential mixed-methods design (Creswell, 2012), and it was found appropriate to conduct it in three different stages or phases. The phase-1 involved pilot testing of research instruments (both student survey and teacher survey-MCLES), and a trial run of the interviews. In the second phase of the study, both the student version and teacher version of the MCLES were administered to students and teachers respectively. During the third phase of the study, semi-structured interviews were conducted to gather qualitative data, which involved both
student and teacher participants. Figure 3.1 illustrates the overview of the plan for the research study (see details in Section 3.4) in terms of its three phases and the associated data collection and analysis.

**Figure 3.1** The overview of the research plan

Thus, the above research plan and design focused on answering the three research questions as follows: 1) assessing students’ perceptions using student survey (MCLES) and student group interviews; 2) assessing teachers’ perceptions using teacher survey (MLCES) and individual teacher interviews; and, 3) examining the contextual factors that influence the mathematics classroom learning environment in Bhutanese schools, using interviews with teachers.
3.2 Research Paradigm, Design and Methods

This section presents a discussion of the research paradigm, research design and methods, which provide theoretical underpinnings to the methodological framework employed in the study. It explains the positivist and interpretive paradigms, mixed-methods design, and survey method and case study approach, and the rationale for their adoption for the current study.

3.2.1 Research Paradigm

A paradigm is a basic set of beliefs that tend to guide human actions and behaviours, and a research paradigm comprises principles, which are human constructions that define the world view of the researcher (Denzin & Lincoln, 2013). A paradigm encompasses four key terms: axiology (ethics in research), ontology (the nature of reality), epistemology (the nature of the relationship between the knower and what can be known), and methodology (the means by which the knower came to know) (Afari, Aldridge, & Fraser, 2011; Creswell, 2009; Dezin & Lincoln, 2013). It was argued that the subject of a paradigm is frequently associated with the ways of knowing and the nature of knowledge (Namgyel, 2011). The ways of knowing are concerned objectively or subjectively, in terms of quantitative or qualitative terms (Creswell & Plano-Clark, 2010).

In general, both positivist and interpretive world views are used to inform research in social sciences such as education, sociology and psychology (Namgyel, 2011). Proponents of positivism view the social world as a set of entities which can be studied objectively and they consider scientific methods as the basis of their argument (Creswell, 2009). They believe in knowing human and social actions through quantitative measures. Hence, the very purpose of conducting research is to
learn more about how the world works, so that events can be then controlled and predicted. In other words, positivism emphasizes the issue of “objectivity, measurability, predictability, patterning, the constructions of laws and rules of the behaviours, and the ascription of causality” (Mustafa, 2011, p. 25).

Proponents of the interpretive paradigm have a different view of social and human actions. They posit that the production of knowledge in the social world is possible only through understanding the environment by interacting with subjects, observing critically their actions and interpreting the meaning of these (Namgyel, 2003). However, the interpretive researcher accepts that the observer makes a difference to the observed and that reality is a human construct (Wiersma, 2000). According to Mustafa (2011), interpretive researchers begin with individuals and set out to understand their interpretations of the world around them, leading to a recognition of the relationship between the researcher and the participants.

Interpretive research is based on the belief that reality can be accessed only through social constructions mediated by language, consciousness and shared meanings (Creswell, 2009). So, the interpretive researcher seeks to understand values, beliefs and meanings of social phenomena, thereby obtaining a deep understanding of human cultural activities and experiences. This approach is appropriate for finding out more about certain structures of experience, the meaning-perspectives of the research participants, and specific interrelationships between participants and their environment. In this approach, understanding reality from the insiders’ points of view and contexts is necessary so that the significance of differences in them can be understood. Thus, the interpretive framework, which is
informed by social constructivist perspectives (McRobbie & Tobin, 1997), is also viewed as the appropriate paradigm for the proposed study to be grounded in.

The present study employed qualitative interviews in order to better understand the views of the research subjects (Denzin & Lincoln, 2013). The research participants were asked to share their views and opinions about their perceptions of the classroom learning environment, which would help interpret the impact of the implementation of the new mathematics curriculum. Hence, the present study was anchored mainly around the interpretive paradigm overlapped with positivist views.

3.2.2 Research Design and Methods

Methodology is the study of methods, encompassing the entire approach to a research study, while a research method is the means by which a researcher collects and analyses research data (Namgyel, 2003). Method is a particular research technique or a way to gather evidence about a phenomenon. It includes those specific tools used in research projects in order to fully understand a phenomenon under study (Namgyel, 2011). They are general techniques used to gather data for inference, interpretation, explanation and prediction (Cohen, Manion, & Morrison, 2000). According to Yin (2009, p. 24), “A research design is the logic that links the data to be collected and the conclusions to be drawn, to the initial questions of the study. Every empirical study has an implicit, if not explicit, research design.” In other words, research methods are a set of techniques used for gathering data to answer research questions (Namgyel, 2003).

This current study was guided by both the positivist and interpretive methodological frameworks (Cohen et al., 2000). It combined qualitative and quantitative data collection to describe and compare students’ and teachers’
perceptions of the classroom learning environment. The use of qualitative methods in learning environment research has provided greater depth to the understanding and examination of learning environments, particularly when they are combined with quantitative methods (Raafflaub & Fraser, 2002). Qualitative data such as student focus group interviews, teacher face-to-face interviews, the researcher’s field notes, document reviews, and classroom observations are useful in helping to contextualize some of the quantitative findings. The use of different sized samples or different groups of participants for different research questions has also been effective in studies that combine different research methodologies (Fraser, 1998b). In other words, the use of mixed methods design in a research study is seen as a means of triangulating data sources as well as a triangulation of methods itself. Allen and Fraser (2007) found that a study’s findings can gain greater credibility through triangulation of quantitative data and qualitative information, as insights gained by one method can be followed up by using the other methods.

Thus, the study involved the “explanatory sequential mixed methods procedure” (Creswell, 2009, p.14), in which the researcher sought to elaborate on or expand the findings of one method with another method. First of all, the study commenced from a more ‘positivist-objectivist paradigm’ (Aldridge & Fraser, 2000), in which the main focus of data collection was the administration of survey questionnaires. It then sought to investigate how unique contextual factors affect the classroom learning environments in Bhutanese eighth grade mathematics classes. The study involved an interpretive approach that included the combination of multiple research methods (Aldridge & Fraser, 2000) such as semi-structured interviews with teachers and focus group interviews with students. Survey data were collected in order to establish to what extent the important elements of the
constructivist approach were incorporated into mathematics classrooms in Bhutan, whereas, qualitative data were used to establish whether the survey-based class profiles can provide an accurate and ‘trustworthy’ description of the learning environment of individual classes.

Though there has been a wide range of debates in regard to the philosophical underpinnings of mixed methods, many researchers agree on the advantages of incorporating different paradigms into a single mixed-method study (Nga, 2014). Some researchers have argued that “a mixed-method approach can help researchers conduct research with clean designs and more rigorous procedures, and ultimately, produce more meaningful study outcomes” (Ivankova, Creswell, & Stick, 2006, p. 18). Mixed-method designs are very helpful in identifying issues, factors, and relevant questions that can become the focus of the quantitative studies (McMillan & Schumacher, 2010, p. 395). It has also been argued that, “Studies using both the quantitative as well as qualitative methods could broaden our understanding of prominent concepts in educational research, such as self-regulated learning” (Rikers et al., 2008, p. 466). Bryman (2007) has maintained that bringing the two sources of data together has the potential to offer insights that could not otherwise be gleaned and it is valuable to consider whether the findings suggest interesting contrasts or help to clarify each other.

Therefore, for the current research, the quantitative and qualitative data sets were collected separately in a sequential mixed method design before finally comparing and contrasting the results. In order to give a general picture of students’ and teachers’ perceptions about their mathematics classroom environments, and identify the sample for the second in-depth studies, quantitative data were first collected to address the research questions 1 and 2. Through this process, the
quantitative data were analysed to explore how students and teachers perceived their classroom environments. The results from this phase informed how a large population views an issue and the diversity of these views. Thus, a quantitative study provides a description of trends, attitudes, or opinions of the respondents (Creswell, 2008; Creswell, 2012), whereas, the qualitative aspect of it provides an in-depth understanding of the given issues and complements the findings from the quantitative data.

3.2.3 Survey Method

Quantitative research is based on a positivist world view. It involves mainly two alternative strategies – experiments and surveys and uses closed questions and predetermined approaches for the collection of numeric data (Creswell, 2009). This research used a survey approach for providing a numeric description of teachers’ and students’ perceptions of the classroom learning environment in Bhutanese secondary mathematics classrooms. Namgyel (2003) defined a survey as a method of collecting information about a human population in which direct contact is made with the units of study – comprising individuals, organizations, communities, and the like – through such systematic means as questionnaires and interview schedules. According to Stangor (2011, p. 107),

……a survey is a research method, in which a series of self-report measures are administered either through an interview or a written questionnaire. Surveys are the most widely used method of collecting descriptive information about a group of people.

The main aim of using a survey in this study was to obtain an overall perspective of what is happening in Bhutanese 8th grade mathematics classrooms in terms of the given dimensions (such as teacher support, material resources, etc.) of
the classroom learning environment. Stangor (2011) maintained that “a survey can be used to produce a ‘snapshot’ of the opinions, attitudes, or behaviours of a group of people at a given time” (p.107). The advantage of a survey is that it can be used to gather information at a particular point in time with the intention of describing the nature of existing conditions. Hence, the use of a survey in this study was viewed to be economical, time-saving, and able to provide a rapid turnaround in data collection (Creswell, 2009).

3.2.4 Case Study Approach

Qualitative research is based on constructivist views or “participatory knowledge claims” (Creswell, 2009, p. 107) that involves various approaches, such as ethnography, grounded theory, case study, phenomenology, and narratives. Data collection methods include interview, observation, document analysis, and text and image analysis leading to themes and patterns interpretation. The current study was qualitatively exploratory in nature as it sought to build an understanding of the nature of Bhutanese 8th grade mathematics classroom learning environments. Therefore, a multiple level case-study approach with interviews as research tool was deemed to be appropriate for the proposed study. The study involved a sample of 31 grade eight students and 5 teachers in three selected case schools, which are located in different settings. Yin (2009) argued that evidence from multiple cases is often more compelling than that from single case designs, and the overall results of the study may be regarded as more valid and reliable.

Case study methods are generally guided by two stand points. The first is that of Stake (1995), in which a case study draws from “naturalistic, holistic, ethnographic, phenomenological, and biographical research methods” (Stake, 1995, p. xi). His way of looking at a case study is purely qualitative in nature, and does not
pay attention to quantitative studies. In contrast to this, Yin (2009) takes a broad, open-ended view about case studies, which takes into account both qualitative and quantitative case studies. She argued that case studies could be exploratory, descriptive or explanatory, depending upon the three conditions: “the type of research questions posed (‘why’ and ‘how’ questions); the extent of control an investigator has over actual behavioural events; and the focus on contemporary as opposed to historical events” (Yin, 2009, p. 2). Hence, since the current study employed a mixed-methods design it also takes Yin’s (2009) stance.

Case studies have become popular in educational settings to study pedagogical practices and teaching and learning in depth. The case study approach allows the use of a variety of methods depending on the circumstances and the specific needs of the situation (Descombe, 2010). They are a suitable approach where the researcher has little control over events, and are applicable to real-life, contemporary, human situations and provide public accessibility through reports. Simons (2009) claimed that the main benefit of the case study approach is the focus on one or a few instances, which allows the researcher to deal with the subtleties and intricacies of complex social situations. So, in order to provide an in-depth understanding of the classroom learning environment, the case study is thought to be appropriate in this study.

3.3 Research Sites and Sampling

This research study was conducted in 2013 with the population of 8th grade students and their corresponding teachers from 22 lower secondary and middle secondary schools at Paro and Thimphu districts, in western Bhutan. Figure 3.2 shows the location of these two districts in the map below.
Paro is one of the districts in western Bhutan, and lies 55 km away from Thimphu, the capital city of Bhutan. It extends over a total area of 1,293.2 km² with an elevation of 2500 m above sea level (National Statistics Bureau [NSB], 2013). It comprises ten blocks, 7118 households and a total population of 40,490, out of which 33,501 live in the rural areas (National Statistics Bureau [NSB], 2013). It is considered as one of the prosperous districts in the country. The only international airport in the country is located at Paro. It is known for several of its religious and cultural sites such as Taktshang monastery, Kyichu monastery, and Tadzong, making it a good destination for tourists. It has a total of 23 schools, out of which four are community primary schools, three primary schools, six lower secondary schools, four middle secondary schools, two higher secondary schools and four private schools (one primary and three higher secondary schools) with a total of 10,917 students and 501 teachers. It also has 21 non-formal education (NFE) centers, 300 NFE learners and 21 NFE instructors (National Statistics Bureau [NSB], 2013).

Thimphu is the capital of Bhutan, and covers a total area of 2,067 km² with an elevation of 2320 m above the sea level (National Statistics Bureau [NSB], 2013). It comprises one dungkhag (subdivision) and eight blocks with a total population of...
98,676, out of which 19,491 live in the rural areas. It is also considered as one of the developed districts in the country. It has a total of 12 schools under the district administration, including one charity school and two extended classrooms (ECR). The other 30 schools are under the Thimphu City Corporation, out of which five are community primary schools, eight lower secondary schools and six middle secondary schools, two higher secondary schools, and twelve private schools with a total of 25,334 students and 1,177 teachers (National Statistics Bureau[NSB], 2012). In addition, it has 16 NFE centres in the rural areas with a total of 435 learners and 23 instructors; and 12 NFE centres in the city with 402 learners and 33 instructors (National Statistics Bureau [NSB], 2013).

The study involved a sample of 22 schools comprising of both lower secondary and middle secondary schools, in which grade 8 classes are taught. This school sample consisted of 10 schools from Paro district (five lower secondary schools and five middle secondary schools), and 12 schools from Thimphu district (five lower secondary schools and seven middle secondary schools). Thus, the surveys were conducted in those 22 selected lower and middle secondary schools, while the qualitative interviews were conducted in three case study schools. The student survey sample comprised 608 year 8 students and the teacher survey sample consisted of 98 mathematics teachers respectively. These schools were chosen purposively to suit the needs of the study.

As suggested by Cohen, Manion and Morrison (2000), the technique of purposive sampling was employed to select the participants and research sites, in order to maximize the positive responses. This technique would help the researcher in identifying subjects who were more likely to satisfy the needs of the study, and this would also allow for flexibility and convenience for the research process.
Wiersma (2000) and Silverman (2010) maintained that purposive sampling allows the researcher to choose a case which illustrates some features in which they are interested. Further, given the limited time for data collection, the researcher had to decide to sample only those schools to which he already had ready access. Hence, the purposeful sampling technique was adopted in the study.

According to Descombe (2010), purposive sampling works well when the researcher already knows something about the specific people or events and deliberately selects ones because they are seen as instances which may produce the most valuable data. The purposeful sampling strategy can also be employed to elicit rich and in-depth information of a typical sample (Creswell, 2009). Considering all these advantages, this sampling procedure was deemed appropriate for the study as well. Descombe (2010) argued that the case study approach generally calls for the researcher to make choices from among a number of possible events, people, organizations, etc., and he or she needs to pick out one example (or just a few) from a wider range of possibilities. It is argued that a case should be chosen deliberately on the basis of specific attributes to be found in the case – attributes that are particularly significant to the researcher's practical problem or theoretical issue (Descombe, 2010).

For the proposed study, considering the practical convenience, three schools were selected from Paro and Thimphu districts (one from Thimphu and other two from Paro). The teachers were also requested to arrange for student interviews in their respective schools and to appoint a convenient time for their students. In addition, the teachers and students were invited for interviews on a voluntary basis, and were informed that they were allowed to withdraw from the study at any stage, without having to worry about consequences of any sort.
3.4 Data Collection

The data collection for the study involved different sources, mainly the use of survey questionnaires to collect the views and opinions of teachers and students of grade 8. The qualitative data were generated using interviews with teachers and students in three selected schools. The details of each source of the data collected are explained in the sub-sections that follow. Figure 3.3 below presents the sources of quantitative data as student and teacher surveys, and qualitative data from teacher and student interviews.

![Figure 3.3 Sources of data for the study](image)

3.4.1 Survey and its Instrumentation

A self-administered questionnaire was used as the main source of data for this study. It was chosen as the most appropriate method of collecting the base information to build up the cases in terms of understanding, which would reflect perceptions of the classroom learning environment. Since a large number of students and teachers had to be involved, the questionnaire was chosen as the most practical option for gathering data. Secondly, it also allowed the collection of a wide variety of both qualitative and quantitative data most economically. Surveys have become one of the most frequently used means of collecting information, and if constructed properly...
they permit the collection of reliable and reasonably valid data in a simple, cheap and timely manner (Punch, 2006).

In this study, the instrument used was the Mathematics Classroom Learning Environment Survey (MCLES) as an adapted version of the What Is Happening In this Class (WIHIC) questionnaire (Aldridge, Fraser, & Huang, 1999) and the Constructivist Learning Environment Survey (CLES) (Taylor et al., 1997). It aimed at establishing to what extent the important aspects of constructivist teaching and learning were incorporated in Bhutanese mathematics classroom contexts as required by the new curriculum. The MCLES consists of eight scales, of which five scales were from the WIHIC questionnaire, and three scales from the CLES. Each of these eight MCLES scales consisted of five items, which made a total of 40 items (8 scales by 5 items) in the questionnaires (see Appendices C and D). The brief description and a sample item for each of these scales are given in Table 3.1 below.

The respondents expressed their opinions about how often each of these classroom practices occurred by each statement given, using five-point Likert scales frequency response alternatives of ‘Never,’ ‘Seldom,’ ‘At times’, ‘Often’ and ‘Always.’ The structure and format of the questionnaire were based on the WIHIC and the items were modified to make them relevant to the context of the study. The two separate versions of the MCLES – student version and teacher version were prepared using the same dimensions of classroom learning environments, but items were modified and changed to make them to suitable to the groups concerned. For example, for the student version, the Item01 under the Teacher Support scale reads, “My teacher takes a personal interest in me,” whereas in the teacher version, it reads, “I take personal interest in my students” (see details in Appendix C and D).
Table: 3.1

MCLES scales and their descriptions with sample items

<table>
<thead>
<tr>
<th>Scales</th>
<th>Scale Description</th>
<th>Sample Items</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WIHIC Scales</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Support (R)</td>
<td>The extent to which the teachers help, befriends, trusts, and interested in students.</td>
<td>The math teacher takes personal interest in me.</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>The extent to which students know, help and supportive of one another.</td>
<td>I make friendship among students in this math class.</td>
</tr>
<tr>
<td>(R)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Orientation</td>
<td>The extent to which it is important to complete activities planned and to stay on the subject matter.</td>
<td>Getting a certain amount of work done is important in math class.</td>
</tr>
<tr>
<td>(P)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooperation (P)</td>
<td>The extent to which students cooperate rather compete with one another on learning tasks.</td>
<td>I cooperate with other students when doing assignments in this subject.</td>
</tr>
<tr>
<td>Equity (S)</td>
<td>The extent to which students are treated equally by the teacher.</td>
<td>The teacher gives as much attention to me as to other students.</td>
</tr>
<tr>
<td><strong>CLES Scales</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical Voice (P)</td>
<td>The extent to which a social climate has been established in which students feel free to express concerns about any impediments to their learning.</td>
<td>I can question the way I am being taught in this class.</td>
</tr>
<tr>
<td>Personal Relevance</td>
<td>The extent to which mathematics connects to students’ outside-of-school experiences.</td>
<td>I learn math can be part of my out-of-school life.</td>
</tr>
<tr>
<td>(R)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Negotiation</td>
<td>The extent to which the opportunities exist for students to explain and justify their ideas to other students</td>
<td>I talk to other students about how to solve problems.</td>
</tr>
<tr>
<td>(S)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: (Aldridge, Fraser, & Huang, 1999; Dorman, 2008; Koul & Fisher, 2003)

Note: R: Relationship; P: Personal development; S: System maintenance and change

There are reasons for why these two particular instruments were appropriate in this study. Firstly, these instruments combine relevant dimensions from various past learning environments instruments such as investigation, and relationships between teachers and students (Dorman, 2003). Secondly, they are the most widely used instruments in the field of learning environment research and have been validated in many countries; as such, the instruments have proven to be cross-culturally valid (Aldridge & Fraser, 2000; Dorman, 2003). Thirdly, the instruments
are capable of reliably measuring students’ perceptions of important elements of their learning environment and has shown predictive validity on both cognitive and affective student outcomes (Fraser, 2002). However, despite their popularity in use among subject areas such as science, technology, and other subjects, they have not been widely used in mathematics classrooms. Hence, the study provided an opportunity to further validate the instruments in terms of their use in mathematics classrooms and countries like Bhutan.

3.4.2 Semi-structured Interviews

Though the quantitative data has the potential to provide a general perspective of student and teacher perceptions of their mathematics classrooms, interviews provide enriched insights. Interviews are widely used as the tools of qualitative research data collection. Punch (2006) considered an interview as an effective way of accessing people’s perspectives, meanings, definitions of situations and constructs, and the most powerful way to understand others. According to Namgyel (2001, p. 65), the “interview is a form of verbal interaction designed to obtain information that satisfies the objectives of an investigation.” It is a useful process of finding out what others feel and think about their worlds, and collecting information about the given issue (Rubin & Rubin, 1995).

The use of interviews in the study was seen as a method of triangulating the data gathered by using survey methods, and acting as complements to it. The interviews are particularly useful for gathering in-depth information around the topic, getting the story behind a participant’s experiences, and understanding something from their point of view (Descombe, 2010). It allows them to convey to others a situation from their own perspective and in their own words. In this study, as a part
of a classroom case study, interviews were used with different groups of participants – teachers and students.

**Individual Interviews with Teachers**

For teacher interviews (N=5), there was a set of predetermined questions (see Appendix E), which were mainly based on the scales of the survey questionnaire, but they were subject to explanation and interpretation in the process of interviewing. So, semi-structured, one-to-one interviews were used with teachers. A semi-structured interview is flexible, allowing new questions to be brought up during the interview as a result of what the interviewee says (Descombe, 2010). In addition, it can be conducted with a fairly open framework, which allows for focused, conversational, two-way communication. In three respective schools, teachers were interviewed as and when it was convenient for them, and, if time permitted and the teachers agreed immediately after their teaching was over. Interviews with each teacher took about 20 to 30 minutes each, and each of teacher was interviewed only once during the whole process of the study.

**Focus Group Interviews with Students**

Interviews with the students (N=31) were conducted in six groups of five members each. As mentioned above, the questions were mainly asked on the MCLES scales. Being guided by societal norms or cultural context, some students were not so open to speak individually with elders or seniors, so at times it was difficult to get responses from some respondents. However, the advantage of group interviewing is that it allowed the gathering of a variety of views and opinions at one point in time, as each group member might differ in their perspective about a particular issue on the agenda. It also allowed for getting in touch with more participants at a time. Interviews with students were arranged after their classes, when all of their classes
were normally over. Also, the setting of interviews was within and around the respective schools’ campuses, for the convenience of the participants, and the researcher. In the process, again their personal convenience, privacy, and time were respected. Each group consisted of four to six members, and each interview took about 20 to 25 minutes.

3.5 Research Procedure and Phases

This section outlines the research phases and practical procedures that were employed in this study. It discusses the process of developing the tools and collecting the data for the study. It describes the steps that were taken in the construction of the questionnaire and its administration, and the procedures that were followed for the interviews. The overview of these three phases of the study plan is given in Table 3.2 below, which was also highlighted in Figure 3.1 earlier under Section 3.1.

Table 3.2

The Research Plan and Procedure

<table>
<thead>
<tr>
<th>Phases of Study</th>
<th>Tools/Actions</th>
<th>Participants</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-study</td>
<td>Obtain ethical clearance and permissions, Develop tools</td>
<td>Researcher Co-researchers</td>
<td>Oct, 2012-Jun, 2013</td>
</tr>
<tr>
<td>Phase 1: Pilot-study</td>
<td>Questionnaires Interviews</td>
<td>Researcher 30 students 7 teachers 16 Student teachers</td>
<td>Jun-July, 2013 (3 weeks)</td>
</tr>
<tr>
<td>Phase 2: Survey Study</td>
<td>Student Questionnaires Teacher Questionnaires</td>
<td>Researcher 608 students &amp; 98 teachers</td>
<td>July-Sept, 2013 (4 weeks)</td>
</tr>
<tr>
<td>Phase 3: Case study</td>
<td>Student Interviews Teacher Interviews</td>
<td>Researcher 26 Students 5 teachers</td>
<td>Sept-Dec, 2013 (8 weeks)</td>
</tr>
</tbody>
</table>

In this study, the quantitative data were collected using a survey method, because it provided a numeric description of opinions of the students’ and teachers’ overall perception of the learning environment in Bhutanese eight grade mathematics
classrooms. Qualitative data were collected using a case-study approach involving
teacher and student interviews. The proposed research took place mainly in two
successive phases – Phase -2 and Phase -3, and the plan of activities for each phase
are discussed below.

3.5.1 Phase 1: Pilot Study
The preliminary study was carried out over a period of three weeks (July to August,
2013) in the two selected schools, which are within proximity of the researcher’s
station. During this phase, the survey instrument was pilot-tested, and the trial
interviews with a few students and teachers were conducted. According to Anderson
(1998), a pilot study refers to the miniature versions of a full-scale study carried out
in preparation for the actual study, which can be used to test research tools such as
questionnaires and interview questions. One of the problems that was likely to be
associated with the study was reluctance on the part of teachers and students to
participate in the research for their unforeseen experiences, especially with
interviews. So, the pilot study was necessary for the proposed study, as it would
provide valuable insights for its success.

The pilot study was aimed at checking the feasibility of the research
instrument and how prospective participants respond to research proceedings. It
helped the researcher in building rapport with the participants and gaining their
confidence and trust (Guba & Lincoln, 1989) in him and in the research. It was also
useful in negotiating his position in their classrooms and explaining the overall
benefits of the study. In addition, the knowledge gained from this phase helped in
identifying potential problems in following the research procedures, and accordingly
rectifying them before the start of the study.
The survey questionnaires were pre-tested at two stages in July-August, 2013. At the first stage, it was trialed with 16 student teachers who were enrolled in the Bachelor of Education (Secondary) course at the Paro College of Education, Bhutan. They were invited to comment on the appropriateness of language, content/items, length and layout of the questionnaire. Based on their comments, some items were deleted and changed accordingly. The questionnaire was improved by modifying or replacing some items that were found to be quite vague. At the second stage, the questionnaires were also pilot tested with seven teachers and thirty students in two selected lower secondary schools (school SC01 & SC02). In accordance with research ethics requirements, permission to conduct a pilot test was sought from the Department of School, Education Ministry of Education, District Education Office, as well as from the school principals.

The review of the questionnaire leaflets pointed out that the questionnaire contained some items that were wrongly structured and incomplete. These findings were useful as they alerted the researcher to check each item carefully. Another finding was that some of the concepts and terms used as scales in the questionnaire caused confusion. The respondents thought that they were required to understand the meaning of each scale, though this was not necessary. The earlier version of the questionnaire contained agreement responses of five-point Likert scales of “Strongly Agree, Agree, Not Sure, Disagree, and Strongly Disagree.” It was noted that some of the statements of items did not tally with these responses. Hence, the agreement responses of the questionnaire were finally replaced by alternative frequency responses of “Never, Seldom, At times, Often, and Always.” Thus, the instrument was modified and the final version of the questionnaire consisted of 40 items, with five items by eight scales of classroom psychosocial environment.
The trial run of the interviews was conducted in the later part of August, 2013 with two teachers and a group of five students at the school SC02 in late June, 2013. It was noted that in a group interview, participants or group members waited for the questions to be answered by other member. So, in the final interview, the researcher decided to directly question participants serially on a rotation basis to each member so that all of them could speak in turn.

3.5.2 Phase 2: The Surveys
This second phase of the study project was commenced in early July, 2013, and ended on September 25, 2013. The study involved a survey of students’ and teachers’ perceptions of their mathematics classroom learning environment, which was conducted as soon as the research ethical approval was received from the university. The researcher conducted the field visits in whichever school was possible in those two selected districts. However, permission to conduct surveys was sought from the Department of School Education, Royal University of Bhutan, District Education Offices, and different school offices in Bhutan. This phase focused on the research question 1 and 2.

Drawing mainly on understanding of the classroom environment issues and findings from the literature, the self-administered questionnaire was initially drafted as early as October, 2012. By the first week of September, 2012, it had undergone several changes and improvements. Due consideration was given to the content coverage, appropriateness of language, and to the importance of keeping it as short as possible. Individual items and scales were analyzed by going back to some of the original classroom environment instruments. All repeated and duplicated items were removed and other items were added accordingly. Any ambiguous items were restructured with the supervisors providing feedbacks. Care was also taken to delete
any items that might in any way demotivate respondents to participate it. The questionnaire items were also further modified and finalized based on the feedbacks and comments received from the pilot-test participants.

**Construction of the Survey Questionnaire**

The survey questionnaire designed for data collection consisted of 40 closed-ended items meant to explore the respondents’ views relevant to the research questions. The questionnaire covered three thematic categories of classroom learning environment dimensions as per Moos’ (1974) scheme, which further consisted of eight scales of classroom environment, consisting of five items each. It included eight classroom environment scales, that is, five scales from the WIHIC questionnaire (Aldridge, Fraser, & Huang, 1999), and three scales from the CLES (Taylor et al., 1997). Each item of the questionnaire was to be responded to with a five point frequency Likert scale of ‘Never,’ ‘Seldom,’ ‘At times,’ ‘Often’ and ‘Always.’ It was argued that the maintenance of anonymity and assurance of confidentiality would increase honesty in the respondents and increase the trustworthiness of the data (Thinley, 1999). In order to ensure anonymity of the respondents, the questionnaire did not include biographical information, except the respondents’ gender, school level and school location.

**Administration of the Questionnaire**

The principals of schools concerned were contacted either through telephone or email prior to the field visits. Most principals, vice principals and class teachers helped in the administration of the questionnaires to mathematics teachers and grade 8 students. Through this support, the questionnaire leaflets were distributed to mathematics teachers and students, who were available at the time of the researcher’s visit to the schools. A total of 680 student questionnaires and 115 teacher
questionnaires were distributed to 22 participating schools during the period August 15, 2013 to September 15, 2013. All questionnaires were distributed in two envelopes enclosed to both teachers and students separately in each school. A time period of 10-21 days was given for the return of the questionnaires. The administration of the questionnaires was completed by September 15, 2013.

3.5.3 Phase 3: The Case Study

The third phase of the study involved three case studies which took place in three selected schools (SC02, SC06, SC13), which were located in different settings (urban, semi-urban, and rural). These case study schools were selected from among those 22 lower secondary and middle secondary schools, which were used for the administration of surveys.

This phase was aimed at developing an in-depth understanding of the perceptions of the participants of mathematics classroom learning environments and complementing the findings of the quantitative data. The proposed case study employed the procedures as explained below. It was scheduled for a minimum of 6 weeks duration; however, it actually took nearly eight weeks. The following simple protocols/guidelines were employed during the conduct of each case study in each of the three schools. These protocols mainly aimed to make the process of study systematic and smooth, and to avoid wasting time and creating unnecessary hassles for the participants and the researcher.

1. Permission to conduct a field visit in schools was sought.

2. Made a preliminary visit to three schools, to talk about the study, and arranged the logistics of the interviews. Drew up a time schedule with the teacher participants.
3. Decided how to go about the field visit of those three schools, either on a rotation basis or devoting two to three weeks to each school site.

4. Interviewed teachers, who were teaching grade 8 mathematics.

5. Interviewed five groups of selected students from three selected schools.

6. Organised data for analysis

7. Analysed data and draw conclusions.

8. Contacted participants as and when required for clarification.

Thus, the interviews formed the major tools of the case studies, which enabled the researcher to further explore the issues raised in the survey through substantive conversation with the respondents, and responses that are richer and more informative than the questionnaire data were gathered. Table 3.3 provides an outline of the case study plan, which was executed during September-December, 2013.

*Table 3.3*

The Outline of Case Study Plan

<table>
<thead>
<tr>
<th>Schools</th>
<th>Grade level</th>
<th>Activities</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC02 LSS</td>
<td>Grade 8</td>
<td>Teacher Interviews</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Section A, B, C</td>
<td>Student Interviews</td>
<td>Sept-Oct, 2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data Compilation</td>
<td></td>
</tr>
<tr>
<td>SC06 MSS</td>
<td>Grade 8</td>
<td>Teacher Interviews</td>
<td>Oct-Nov, 2013</td>
</tr>
<tr>
<td></td>
<td>Section A, B, C</td>
<td>Student Interviews</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data Compilation</td>
<td></td>
</tr>
<tr>
<td>SC13 LSS</td>
<td>Grade 8</td>
<td>Teachers Interviews</td>
<td>Nov-Dec, 2013</td>
</tr>
<tr>
<td></td>
<td>Section A, B</td>
<td>Students Interviews</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data compilation</td>
<td></td>
</tr>
</tbody>
</table>
Purpose and Content of the Interviews

The interviews in this study were intended to triangulate some of the unexpected and interesting response patterns which might emerge out of the quantitative data, and draw out deeper meanings on some other responses (Thinley, 1999). They would thus help to portray multiple views of the case. The interview schedules contained five to eight main questions, which were mainly based on the eight constructs of the MCLES questionnaire. These questions also covered the general and more qualitative areas of the research. Student interviews were used to provide a sense of what was happening in the class and why students responded to items in the way in which they did. Discussions with each of the teachers were based on the problems and successes experienced by the teachers as they were implementing the new curriculum with new approaches in their classes. It was envisaged that discussion on each issue would lead to other issues and insights not picked up in the questionnaire. The interview questions used for both the students and the teachers were similar in regard to the MCLES scales. However, the questions in regard to the exploration of contextual factors were not explicitly emphasized for students, as these may be beyond their understanding.

Selection of Interview Samples

A sample of three teachers and 11 students from the school SC02, two teachers and 15 students from the school SC06, and 5 students from the school SC13 were interviewed. Hence, the interview study involved a total of 36 participants, which included 31 students (9 boys and 22 girls) and 5 mathematics teachers (4 males and 1 female teacher). Though a structured random sample was thought to be the most appropriate method for the selection of the interviewees, in the study participants’ willingness to participate was the major criterion to invite them for the interviews. In
selecting student interviewees due consideration was given to those whom the focal teachers and principals thought were better informed and could better express themselves. Some of the students and teacher interviewees in these case schools were also the respondents to the questionnaires. The school principals or focal teacher participants were requested to arrange any teachers and students who were interested in participating in the study from amongst those who had also participated in the questionnaires.

**The Conduct of Interviews**

The interview process involved a total of 11 interviews, including five group interviews with 31 students (9 boys and 22 girls), and 5 individual interviews with the mathematics teachers (4 males and 1 female teacher). Interviews were conducted during the eight weeks study period (that is, from September 20 to December 31, 2013). All interviews were conducted in English, because most subjects including mathematics are taught in English in Bhutan. Each interview took from 18 to 30 minutes depending on whether the interviewees had much to say and whether the probes were producing interesting data or not.

Each interviewee was contacted a day or two in advance and invited to nominate a time that best suited his/her convenience. The interviews were audio recorded with the permission of the interviewees and at the same time, daily process notes were maintained to supplement the actual interviews and transcription. The researcher was aware of the limited sample and its effects on the research results. Though a larger sample would have enriched the research results, the researcher thought the sample used would suffice as the study was designed to be an exploratory one (Namgyel, 2011). In addition, time constraints were another determinant of the overall number of participants.
3.6 Data Analysis Procedures

As the study employed a mixed-methods design, it involved both quantitative as well as qualitative data analysis. Hence, the study was guided by both positivist and interpretive procedures (Erickson, 1998). The data analysis involved examining, categorizing, tabulating, testing, or otherwise recombining evidence, to draw empirically based conclusions (Yin, 2009). Hence, data was analysed considering the following areas: students’ perceptions of classroom learning environment; teachers’ perceptions of classroom learning environment; and students’ and teachers’ perceptions of contextual factors which influence classroom learning environments. However, before the data were analysed, the process of data cleansing and compilation was carried out for both quantitative and qualitative data, which is discussed in the following sub-section.

3.6.1 Data Cleansing and Compilation Procedures

The process of quantitative data cleansing and compilation started from September 19, 2013 and went on until September 26, 2013. First of all it involved counting how many questionnaires had been returned out of the total of 680 student questionnaires and 115 teacher questionnaires that had been distributed. It then involved determining how many questionnaires were returned with consent forms, and with proper and complete responses to all items in the questionnaires. Each questionnaire leaflet was given a serial number or identity number from 1 to 608 for students and 1 to 98 for teachers, and with their respective school code numbers.

The survey questionnaires collected only one type of data, numbers as the questionnaire was designed only to employ pre-coded items with five-point Likert scale alternative answers. The numbers came from the self-rating scales for various
items in both student and teacher questionnaires. Data compilation started as soon as the questionnaires were received, and this had to be done in two steps.

Firstly, each of the questionnaires returned was marked in the checklist of returns. It was then followed by checking all the contents to see if any questionnaire was returned empty or answered partially. Each questionnaire was screened to find discrepancies in giving responses to each item. In order to prevent any possible distortions during analysis, the omissions and anomalies detected were weeded out accordingly (Namgyel, 2011). Responses that seemed to give extra complications were ‘cleaned up.’ For example, some participants ticked or circled two or more responses to an item. In such cases, the responses were considered null, and not entered. There were a few respondents who did not indicate their ratings to items, and such items were also excluded. The final tally revealed that out of 680 participants, the number of respondents was reduced to 608. Among the missing questionnaires, some were not returned at all, some had missing responses to one or more items, and others did not have their parents’ or their own consent forms attached. The actual return rate of questionnaires for this study was 78.52% in the case of student surveys, whereas in case of teacher surveys it was 85.20%, much more than usually expected (Cohen et al., 2000).

The second step involved the entry of data collected into the computer system, which had to be done in two categories. Firstly, the general data in the questionnaire were coded as follows: a. Gender: Male=1, and Female=2; b. School Level: LSS=1, MSS=2; and c. School Location: Urban=1, Semi-urban=2, and Rural =3. Secondly, the numerical data contained codes for five alternative frequency responses rated by the respondents against each item of the questionnaire (Never =1, Seldom=2, At times=3, Often=4, and Always=5). The data were then entered into the
Statistical Package for Social Sciences (SPSS) program directly for analysis, using simple descriptive statistics, and other statistical analyses as will be presented later in Chapter 4. SPSS is a statistical software package used to analyse quantitative data for the social sciences (Smeal, 2008). The SPSS software version 21 was used for statistical analyses, and wherever necessary the Microsoft Excel program was also used, especially for converting SPSS output tables into APA format.

In regard to qualitative data, the responses to the interview questions by each respondent and group were first compiled into individual files in Microsoft Word. There were 11 individual documents. Each of these files was converted into a text file. Each interview transcript was given an identity number for a group of students and teacher interviewees respectively. The interviews were transcribed using a Word template, and saved as Word documents. These documents were later saved as ‘text only with line breaks.’ The base data was in the same format for interviews as that for the questionnaire. Responses to the interview questions were varied in terms of length among interviewees. To the best of his capability, the researcher took care to transcribe exactly what the interviewees said. In other words, the researcher tried to transcribe the original language (grammar/vocabulary) of the participants.

### 3.6.2 Quantitative Data Analysis

Survey data were analysed applying different statistical measures; especially the method of descriptive statistics and the quantitative findings were interpreted. The responses to the questionnaire items were compiled and entered into a spreadsheet file. This file was then analysed using the SPSS as well as Microsoft Excel programs. The survey data were analysed quantitatively to compare the teachers’ and students’ perceptions of their classroom environments in terms of three background variables—gender, school level and school location.
Firstly, the quantitative data analyses involved reliability analysis, discriminant validity analysis, and principal component factor analysis. The coefficient alpha measures the internal consistency of the items in the surveys and aids in establishing internal reliability (Smeal, 2008). The Cronbach’s alpha coefficient was used as a measure of the internal consistency reliability of each scale of the research instrument. This was necessary to ensure the extent to which each item in a scale assessed the same construct. For each scale of the MCLES, reliability analysis was undertaken for one unit of analysis (the student), and the findings were reported in Chapter 4 (see Section 4.4). Similarly, discriminant validity analysis was carried out for each of the MCLES scales in order to establish the extent to which each scale measured a unique dimension which is independent of the other scales in the instrument (Ching-Tse, 2013). In this study, the mean correlation of a scale with the other seven scales was employed as a convenient index of discriminant validity. Hence, the mean correlation for each of the MCLES scales was also calculated in order to test the construct validity of the research instruments. Only one unit of analysis was used, that is, individual student or teacher means. The following chapter presents the findings for this analysis (see Section 4.4).

Statistical analyses were conducted to examine the internal structure of the 40 items in the student and teacher versions of the MCLES used in the current study. Principal component analysis (PCA), with various rotation techniques such as varimax, equamax, and quartimax was used to generate orthogonal factors for each the two data sets (student survey and teacher survey). However, since the equamax rotation provided the best results for the given samples, it was deemed appropriate for use in the study. PCA or factor analysis is a statistical tool that analyses the data from surveys and looks for patterns of participant responses (Abdi, 2003).
Meaningful patterns lead to the determination of factors. The principal component factor analysis finally resulted in acceptance of revised versions of the instrument, comprising 35 items in the student questionnaire and 37 items in the teacher questionnaire respectively. Thus, after elimination of 5 items from the student version and 3 items from the teacher version, the *a priori* factor structure of the original instruments was replicated in both the versions of MCLES, with almost all the items having a factor loading of at least 0.30 on their own scale. The PCA results are presented later in Chapter 4 for student and teacher samples respectively.

For investigating students’ and teachers’ general perceptions of the classroom learning environment, the means and standard deviations for each MCLES scale were calculated, and then those mean values were compared among the eight scales of MCLES and conclusions were drawn (Dorman et al., 2004; Koul & Fisher, 2003). In addition, item-wise analyses of mean and standard deviation were also conducted to add credibility to the findings of the study. Students’ and teachers’ perceptions of their classroom learning environment were further investigated using independent samples t-test, one-way analysis of variance (ANOVA), and effect size in terms of gender, school level and school location as independent variables.

According to Christensen (2007), “Independent samples t-test is a statistical test for analyzing the data obtained from two different groups of participants to determine whether the group mean difference is so large that it could not reasonably be attributed to chance” (p.415). In this study, the t-test was used to differentiate between the perceptions of students and teachers based on gender and school level on each of the MCLES scales. In other words, it was used to test if there are statistically significant differences in means of each MCLES scale in terms of gender and school level.
Analysis of variance (ANOVA) is defined as “a method of analysing and understanding the simultaneous relationships among variables” (Yee, 2011, p. 92). It can be used to test whether there is a statistically significant difference in the means among two or more groups of variables (McMillan & Schumacher, 2010). In this study, ANOVA was used to differentiate between the perceptions of students and teachers based on school location on the each of the MCLES scales. ANOVA involves the use of mean and standard deviation, and the F-value to identify the degree of difference between means (Yee, 2011). At the same time, the p-value is also calculated to give an indication of the level of statistical significance of the F-value (McMillan & Schumacher, 2010).

According to McMillan and Schumacher (2010, p. 315), “Effect size is the difference between two means in standard deviation units and it is used to illustrate the strength or magnitude of a difference or relationship along with measures of statistical significance.” Thus, the effect size gives an estimated magnitude of the differences between students’ and teachers’ mean scores on the MCLES scales, as suggested by Thompson (2001) cited in Trinidad, Aldridge, and Fraser (2005).

In this study, the independent variables were gender, school level, school location, while the dependent variables were the eight scales in the MCLES (see Table 3.4 below). The results of the mean, standard deviation, effect size and analysis of variance (F-value) of each dependent variable were analysed. From these analyses, it was hoped to understand the statistical significance of the differences between the perceptions of students and teachers towards their mathematics classrooms. The analyses also may lead to further understanding of the quality of Bhutanese mathematics classrooms so that the teachers can improve their teaching practices accordingly.
Table 3.4

Dependent Variables and Independent Variables of the MCLES

<table>
<thead>
<tr>
<th>Independent Variables (n=3)</th>
<th>Dependent Variables (n=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Teacher Support (TS)</td>
</tr>
<tr>
<td>Male</td>
<td>Student Cohesiveness(SC)</td>
</tr>
<tr>
<td>Female</td>
<td>Task Orientation(TO)</td>
</tr>
<tr>
<td>School Level</td>
<td>Cooperation (CO)</td>
</tr>
<tr>
<td>Lower secondary schools</td>
<td>Equity(EQ)</td>
</tr>
<tr>
<td>Middle Secondary Schools</td>
<td>Critical Voice (CV)</td>
</tr>
<tr>
<td>School Location</td>
<td>Personal Relevance (PR)</td>
</tr>
<tr>
<td>Rural schools</td>
<td>Student Negotiation (SN)</td>
</tr>
<tr>
<td>Semi-urban schools</td>
<td></td>
</tr>
<tr>
<td>Urban schools</td>
<td></td>
</tr>
</tbody>
</table>

3.6.3 Qualitative Data Analysis

Qualitative data analysis involves a systematic process that organizes the data into manageable units, combines and synthesizes ideas, and develops constructs, themes, patterns or theories (Dukpa, 2000). The qualitative data arising from student and teacher interviews were analysed to support and validate the findings from the quantitative data. According to Yin (2009), four strategies to analyse case studies are: relying on theoretical propositions, developing case descriptions, using both qualitative and quantitative data, and examining rival explanations (p.126). Descombe (2010, p. 240) proposed five general stages of qualitative data analysis:

1. Data preparation: Catalogue the text or visual data, prepare the data and load to software (if applicable), transcribe the text.

2. Initial exploration of the data: Look for obvious recurrent themes or issues, add notes to the data, write memos to capture ideas.

3. Analysis of the data: Code data, group the codes into categories or themes; compare categories and themes; look for concepts that encapsulates the categories.
4. Presentation and display of the data: Written interpretation of the findings, illustrate points with quotes and pictures, use of visual models, figures, and tables.

5. Validation of the data: Data and method triangulation, member validation, comparison with alternative explanations.

Hobson and Noyes (2011) proposed to use Burnard’s method of analysing interview data. In this approach, interviews are recorded and transcribed verbatim. Here meaning units are described as a discrete phrase, sentence or series of sentences which convey one idea or one related set of perceptions. Each transcript is then read and re-read by the researcher, and the texts are then highlighted and organised into meaning units to which are attached labels. In an ongoing iterative process, the researcher spends time developing and refining the meaning units, and developed overarching category system that captured all meaning units. This is done by charting and mapping discrete words, sentences and series of sentences until the meaning units are finalized, and then grouped together in a category system that accounts for all meaning units.

In this study as soon as the interview data were collected, they were processed and filed in a way that made them amenable to analysis on a daily or weekly basis. In order to protect the original data, backup copies were created. It is advisable to use backup copies for the analysis, so that we can protect the original data. Secondly, the data were catalogued and indexed, and for this, each piece of raw data was assigned with a unique serial number for reference purposes.

Then, audio recordings of interviews were transcribed, allowing sufficient time for the transcription process. The process of annotations (the researcher putting informal notes and comments alongside of the interviewee’s words), and line
numbering and coding were used (Descombe, 2010). Especially in paper interview transcripts, each line in the transcript should ideally have a unique line number by which to identify it. This helps to locate data in different parts of the transcripts and to navigate through to particular points. The transcription took place as the research progressed, and this led to developing themes and patterns through coding. Once the transcription was completed, it was reviewed with the audio recordings and field notes to crosscheck that nothing was left out and that the non-verbal cues were taken into consideration. The technique of member checking (allow participants see their own transcripts) was also used with participants, and changes were made accordingly in the transcripts.

In this study, textual data collected via interviews were transcribed referring to files, which were recorded in the computer. The data was cleaned up by way of deleting those responses to questions, where participants had not responded properly. Separate files were created for each of the 11 interview transcripts. Interview data were coded manually, which was useful for learning the skills of coding, particularly for the researcher as a beginner. The researcher read the data several times because analysis initially consists of developing a general sense of the data, and then coding description and themes about the central phenomenon (Creswell, 2008). The key phenomena in the study were the perceptions of the classroom learning environment and it was intended to explore how the students and teachers perceived their mathematics classrooms in relation to the new curriculum.

3.7 Research Quality Standards

The quality standards of a quantitative research project can be judged using the criteria of validity, reliability, generalizability and objectivity (Descombe, 2010).
However, this study is mainly concerned with the issues of reliability and validity, which are discussed below.

*Reliability* refers to the extent of replicability and consistency of the research methods, conditions and results (Stangor, 2011; Wiersma, 2000). It is concerned with whether the research instrument is neutral in effects and consistent across multiple occasions of its use (Descombe, 2010). It is the consistency, stability, or repeatability (Christensen, 2007) of measurement or the degree to which an instrument measures the same way each time it is used under the same conditions with the same subjects (Mark S. Litwin, 1995). The study used only the method of internal consistency, because it is one of the commonly used psychometric measures in assessing survey instruments (Mark S. Litwin, 1995). Internal consistency indicates how well the different items measure the same attribute or issue. In this study, the internal consistency was measured by calculating Cronbach’s alpha coefficients for each scale of the MCLES.

*Validity* is normally associated with the accuracy and precision of the data, and is concerned with the appropriateness of the data in terms of the research question being investigated (Descombe, 2010). The validity of research deals with the accurate interpretability of the results (internal validity) and the generalizability of the results (external validity). In this study, the validity was established by triangulating the data collection methods and responses from the participants. Data triangulation means the use of different data sources, which helps in eliminating biases and detecting anomalies in findings (Anderson, 1998).

For the survey data, the validity was ensured by conducting the pilot test of the instrument, and using well-established existing instruments – the WIHIC
questionnaire (Aldridge, Fraser, & Huang, 1999) and the CLES (Taylor et al. 1997) as the basis of the survey questionnaires. In addition, the discriminant validity tests were conducted to ensure the construct validity of the MCLES scales, and enhance the reliability of the research findings.

According to Maxwell (1992), the credibility of the qualitative data can be judged using the following criteria to resolve the issues of ‘representation’ (question of representing others) and ‘legitimation’ (question of credibility and trustworthiness).

Credibility (which is parallel to validity in quantitative study) is concerned with the extent to which qualitative researchers can demonstrate that their data are accurate and appropriate. The techniques such as triangulation, respondent validation (return to participants with data and findings to check the validity of findings), and grounded data (based on field work and empirical data) contribute to enhancement of the credibility of the research.

Dependability is the second criterion that corresponds to the concept of reliability in quantitative research. In qualitative data gathered through interviews and observations, the researcher’s self tends to be very closely bound up with the research instrument, and at times becomes an integral part of it. Hence, the reliability of the study is questionable, whether it will produce the same results or not when used by different researchers. So, an audit trail should be constructed and mapped out for the reader, allowing them to follow the key decisions taken by the researcher from conception of the research through to the findings and conclusions derived from the research. An audit trail, as a check on the reliability of the research, refers to the practice of keeping a detailed record of the process of the research decisions,
including methods, analysis, and decision-making (Descombe, 2010). The research process must be open for audit by other researchers.

*Confirmability* (Objectivity) refers to the extent to which qualitative research can produce findings that are free from the influence of the researcher who conducted the inquiry. In order to meet the criterion of confirmability, the researcher tried his best to base the findings of the study as much as possible on the data and literature and give the best of arguments and explanations for the findings.

*Transferability* is one of the trustworthiness criteria of interpretive research. It refers to the degree to which the research findings are relevant to others across educational settings (Bryman, 2004). It is concerned with how well readers are able to judge the extent to which this research might be applicable to their own contexts, groups, and entities. It may be taken as parallel to external validity (generalizability). So, the researcher had to provide descriptions from his own experiences and interpret the data to uncover the truth for readers to understand and assimilate the ideas in their cultural framework. The major technique for establishing transferability is ‘thick description’ (Guba & Lincoln, 1994), which was appropriate to use in this study in regard to the context, the time, the place and the culture.

### 3.8 Ethical Considerations

The practice of educational research involves people within a context, and as the researcher interacts with the community, such research requires social and cultural considerations. In fact, all human behaviours and actions are subject to ethical principles, rules and conventions (Anderson, 2004). So, in order to minimize possible risks that the research process may cause in the community under study or to individual participants, there is a need to consider these obligations that the
researcher owes to them, which are known as the ethics of the research process (Bryman, 2004). According to Burns (2000), there are many potential sources of ethical issues in a research project, such as: the nature of the project itself (for example, gender difference in cognitive abilities); procedures to be adopted (the potential to cause anxiety); methods of data collection (covert observation and tests); the type of data collection (personal information, criminal records); and what is done with the data (participant embarrassment due to publication).

Further, Erickson (1998) argued that researchers are obliged ethically to anticipate what will be done in data collection, analysis and reporting, and to explain to those studied why it will be done that way rather than some other ways. According to Hennink, Hutter, and Bailey (2011) researchers must abide by the three core principles of ‘respect for persons, benefice, and justice’ for the ethical conduct of research. The application of these principles in the research will lead to ethical considerations such as informed consent, self-determination, minimization of harm, anonymity and confidentiality. According to Stangor (2011) and Silverman (2010), the following are five general standards of ethical research that most researchers would agree with.

*Informed Consent.* The first principle is that research subjects must be informed about the purpose, methods, and intended possible uses of the research, what their participation in the research entails and what risks, if any, are involved. Informed consent entails giving as much information as possible about the research so that the prospective participants can make informed decisions on their possible involvement (Silverman, 2011). This information should be provided in written form and signed off by the research subjects. The main objective is to conduct the research openly and without deception (research with consent).
Thus, participants involved in this research were provided with the sufficient information about it, with the researcher distributing participant informed consent forms (PICFs) or meeting them personally. The cover letters for seeking approvals and participant informed consent forms that accompanied research instruments also explained the purpose and intentions of the study. The researcher personally explained the purpose of the study to interviewees. The researcher tried to take optimum care in considering the opinions and beliefs of the respondents.

*Voluntary participation and the right to withdraw.* Research participants must participate in a voluntary way, free from any coercion. In all cases of research, researchers should inform subjects of their rights to refuse to participate or withdraw from the investigation whenever and for whatever reason they wish (Silverman, 2011). There should be no coercion of research subjects to participate in the research, and consent should be freely given in order to validate the research findings.

The participants’ informed consent forms outlined information about the freedom of their participation and their ability to withdraw at any stage of the study, and the withdrawal of informed consent forms were circulated among the participants. In this study, individuals had the right to determine their own participation in research, including the right to refuse participation without any consequences. So, the participants’ individual time, rights and convenience were respected throughout the research process.

*Minimization of harm to research participants.* This principle requires that research should be conducted in such a way that it minimizes harm or risk to social groups or individuals (Hennink et al., 2011). Participants’ interests or well-being should not be damaged as a result of their participation in the research study. Any researcher must ensure that he or she does not put his or her participants at risk of
any kind or intimidate them in the process of study (Cohen, Manion, & Morrison, 2007).

Protection of research participants. The independence and impartiality of researchers must be clear, and any conflicts of interest or partiality must be explicit (Hennink et al., 2011). The research must be conducted so as to ensure the professional integrity of its design, the generation and analysis of data, and the publication of its results. Be it any research instruments, such as self-administered questionnaires or interviews, or class observations, the researcher must take sole responsibility to protect participants and make them feel comfortable, protected, and not intimidated. This is because without assuring their maintenance of confidentiality and anonymity, the findings of the intended data may not be valid or reliable. Besides, the direct and indirect contributions of colleagues, collaborators, and others to the research process should also be duly acknowledged.

Assessment of potential benefits and risks to participants. The confidentiality of information supplied by research subjects and anonymity of the respondents must be respected (Silverman, 2010, 2011). In order to comply with this standard, the researcher tried to ensure that data and its sources remained confidential unless the research participants had consented to their disclosure, and, in the latter case, to ensure that plans had been made for their storage and access to them. In addition, the researcher also took sole responsibility to ensure that all data records of the project were kept confidential at all times, and will not be revealed to any other individuals, groups or organizations.

In addition, ethical considerations concern mainly three stages of the research process: pre-data collection, during data collection, and post-data collection (Namgyel, 2011). Firstly, in order to make a study valid and reliable and to fulfill the
University norms, it is important for the accrediting body to approve the study. As this research study was conducted under the auspices of Queensland University of Technology, Australia, and its research policy requires any researcher to seek prior approval. Thus, the QUT Human Research Ethics Committee accorded the ethics approval No.130000060 valid from June 10, 2013 to June 10, 2016 (For details of participant information and consent forms used see Appendix A).

Further, the researchers are morally obliged to apply for and receive consent of the other institutions and organizations that are responsible for the proposed research participants (Namgyel, 2011). Therefore, the approvals and permissions were sought from various organizations such as the Department of School Education, Ministry of Education, Bhutan; City Education Office, Thimphu, Bhutan and two District Education Offices, and from all school authorities (see Appendix B) before the start of the data collection.

Another ethical issue involved during the data collection, was concerning audio recording of the interview conversations. In order not to lose data and responses, the researcher audio recorded the interviews. Due permission was sought from each interviewee. The researcher supported audio recording by diligently engaging himself in note taking during the process of interviews.

The researcher is ethically obliged to the participants even after data collection is over, and it is as important as before and/or during data collection (Namgyel, 2011). During this stage, it mainly involves the storage of the data, access to them, analyzing them and to publish the same (Creswell, 2005). The researcher maintained the data that were collected using questionnaire, and interviews. They were stored in a filing cabinet under lock and key for ensuring their safety. The
researcher provided pseudonyms or, alternatively, identity code numbers to each participant when data were entered into the computer programs for analysis.

The next concern was access to the information. At the initial stage, only the researcher and his supervisory team could access the collected data. At a later stage, if necessary, the Office of Education Research, QUT may also have access to them. In consultation with the researcher, other researchers in the same field could also have access if the future study was to be carried out within two or three years from the time of this initial data was collected.

3.9 Chapter Summary

The chapter highlighted a wide range of practical procedures and methods, in most cases referring to theoretical perspectives to underpin the rationale behind making selection from a number of options. Both the positivist and interpretivist views were found appropriate knowledge claims to ground the current study. A mixed-methods research approach of ‘Quan-qual Model’ (Namgyel, 2011; Creswell, 2010) was selected for this study’s design because, firstly, it provided diversity of views, and, secondly it strengthened the validity and reliability of the findings of the study. More importantly, it required the researcher to have a certain level of competency in both the approaches of research and was considered useful at this learning stage.

Next, the discussion delved into concepts of research sites and samples, and the rationale behind selecting purposive sampling as an appropriate technique to draw various samples for the study. This was followed by a discussion of data collection methods used and the research procedures used in terms of the three phases of the study. The timeline for completion of each stage of the study was outlined. The discussion then presented how data were analysed including data cleansing and compilation, and the analysis procedures of both quantitative and
qualitative data. The use of descriptive statistics, independent sample t-test, one-way ANOVA, and effect size took precedence as far as the quantitative data analysis was concerned. The section also discussed on how qualitative data are analysed, including the process of transcribing, coding, categorizing, and thematic grouping.

The seventh section highlighted quality standards, with a discussion of criteria for ensuring quality standards. This included validity, reliability, objectivity, and generalizability for the quantitative survey. For the qualitative study, the criteria of credibility, dependability, confirmability and transferability were discussed. Finally, the last section discussed the ethical considerations of the research and its potential problems and limitations. Ethical issues were mainly concerned regarding obtaining informed consent, voluntary participation and the right to withdraw from the study, harm to research participants, protection of research participants, and assessment of potential benefits and risks to participants. In conclusion, the research design chosen, research procedures employed, and ethics considered, all concentrated to address the issues of validity and reliability of the study.
Chapter 4: Quantitative Data Results

4.1 An Overview

This chapter reports on the findings from the analysis of survey data that were collected in this study. The Mathematics Classroom Learning Environment Survey (MCLES) was administered to the sample of students (n=608) and teachers (n=98) separately. These two surveys were intended to paint a big picture of the perceptions of the participants about Bhutanese eighth grade mathematics classrooms. This chapter presents the data in three broad sections: (Section 4.2) Student Survey Results; (Section 4.3) Teacher Survey Results, and (Section 4.4) Summary of the Survey findings.

The means and standard deviations for each scale of the MCLES were calculated to understand the classroom learning environments. Additional statistical analyses were also included in this investigation: Reliability analysis, discriminant analysis, independent samples t-test, one-way analysis of variance, and effect size. The results of these analyses created further opportunities to understand the data. Each of these analyses was carried out for both the student and teacher surveys. Three independent variables used for analyses were – gender, school level and school location.

The research study was constrained by time and other factors (such as money, internet facility, fax, telephone network, and road networks), and added by geographical conditions during the study period. For this reason, a purposive sampling technique was deemed appropriate for data collection in this study. Student and teacher samples were gathered from selected lower secondary and middle secondary schools from two western districts of Bhutan within easy reach of the
researcher. Figure 4.1 gives an overview of the quantitative data analyses that were conducted for both the student and teacher surveys.

Figure 4.1 Overview of the quantitative data analysis

As shown in the figure above, both the student survey and teacher survey data were analysed using various statistical measures with the support of SPSS software version 21 and Microsoft Excel. These analyses mainly involved reliability analysis, discriminant validity analysis, mean and standard deviation, one-way analysis of variance, and independent samples t-test and effect size. Accordingly, the results were computed and organised into tables and presented without discussion and interpretations. However, the discussion of the main findings of the study is presented in Chapter 6.
Research in the past has explored students’ and teachers’ perceptions of their classroom learning environments. These were explored in the context of gender, grade level, school type, school location and learning outcomes (Aldridge, Laugksch, & Fraser, 2006; Fraser, 1998a; Huang & Fraser, 2009). Such studies have been beneficial in understanding the impact of reform agendas on education systems that have been mandated by education jurisdictions in various countries.

Many researchers support the view that students develop different perspectives of the classroom environment as they progress through their school years. According to LaRoque (2008),

Examining the classroom environment from the perspective of the students appears to be most promising for understanding the educational process. Students are in an excellent position to provide data about this environment as they themselves are participants and more able to assess information that an observer may miss or consider unimportant (p. 289-290).

Thus, students’ perceptions of the classroom learning environment influence the way in which students actually learn (Abell, Jung, & Taylor, 2011), meaning they learn better when they perceive their classroom environment more positively (Dorman, 2008; Fraser, 1998a). Students’ perception of their classroom environments thereby serves as a useful construct in predicting achievement and school satisfaction. Therefore, understanding students’ perceptions is important – especially in this study’s context where a new mathematics curriculum for schools is being implemented.

In addition, classroom learning environments as perceived by teachers also have a number of characteristics that influence student growth, development and achievement (LaRocque, 2008). Since the teacher is an important participant and
observer of the educational process, his or her perceptions determine to a large extent the learning and social processes of the students (Raviv, Raviv, & Reisel, 1990). It is claimed that classrooms that are perceived as safe, warm, supportive and non-threatening lead to encouragement and promotion of a sense of enjoyment and accomplishment in students (LaRocque, 2008). This implies that the teacher has a sacred responsibility to create a positive learning environment for his or her learners. Hence, this study also investigated the teachers’ perceptions of their mathematics classroom environments in Bhutanese eighth grade classrooms, within the purview of the implementation of the new curriculum. This gives an additional value to this study, because many past research studies failed to recognize the significance of teachers’ perceptions of their classroom environments, which has important implications for student learning and academic achievements.

4.2 Quantitative Data: Student Survey Results

This section deals with students’ perceptions of classroom learning environments, which pertains to the Research Question 1: *What are Bhutanese grade eight students’ perceptions of their classroom learning environment in relation to new mathematics curriculum?* The student survey was administered to ascertain the views and opinions of grade eight students (13-14 year olds) in Bhutanese lower and middle secondary schools about their mathematics classroom learning environment.

4.2.1 Distribution of Student Survey Respondents

A sample of 608 year 8 students from 22 lower secondary and middle secondary schools from two districts, Paro, and Thimphu, in western Bhutan (see Figure 3.3, p.97), responded to the Mathematics Classroom Learning Environment Survey (MCLES) questionnaire. The student survey sample represented approximately 5%
of the total population of 12,775 year 8 students in Bhutan (National Statistics Bureau, 2013).

**Student Survey Participants by Gender**

Table 4.1 shows the distribution of student samples in the MCLES by gender. Out of 608 student participants, 267 (43.9%) were boys and 340 (55.9%) were girls.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>267</td>
<td>43.9</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Female</td>
<td>340</td>
<td>55.9</td>
<td>56</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>607</td>
<td>99.8</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Missing Values</td>
<td>1</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>608</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.1: Distribution of Student Survey Participants by Gender

There were more female participants in the sample than males. This mirrors student numbers in grade 8. In July, 2013, there were 12,775 students in this cohort – 6,128 were boys and 6648 were girls (National Statistics Bureau, 2013).

**Student Survey Samples based on School Level**

In Bhutan, schools are broadly divided into four levels: primary (PP-year 6), lower secondary (grade 7-8), middle secondary (grade 9-10) and higher secondary (grade 11-12). Those schools which have grade 8 as their graduating class are called lower secondary, while schools that have grade 10 or 12 as their graduating classes are called middle secondary and higher secondary schools respectively (Policy & Planning Division[PPD], 2012). Thus, though middle secondary schools (MSS) in the Bhutanese context, refer to those schools which have grade 9 and 10 only, there are some middle secondary schools which also include grade 7 and 8 classes, and
even some of them even admit primary classes. Lower secondary schools in Bhutan usually have pre-primary to grade 8, though they are conceptually meant for grade 7 and 8 only.

In this study, out of the samples of 608 grade 8 students, 333 (54.8%) were from lower secondary schools and 275 (45.2%) from middle secondary schools. The representation of year 8 students from lower secondary schools (LSS) was slightly greater than the representation from middle secondary schools. Table 4.2 provides the distribution of student participants in the survey in terms of school level.

**Table 4.2**

Distribution of Student Survey Samples based on School Level

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSS</td>
<td>333</td>
<td>54.8</td>
<td>54.8</td>
<td>54.8</td>
</tr>
<tr>
<td>MSS</td>
<td>275</td>
<td>45.2</td>
<td>45.2</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>608</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

The table above indicates that the representation of students from lower secondary schools is slightly larger than from middle secondary schools, which is consistent with the national statistics given in Table 4.3.

Table 4.3 gives the total number of students in secondary schools in Bhutan as of July 2013, and the number of male and female students in the lower secondary and middle secondary schools as a whole. This statistics includes both grade 7 and 8 in lower secondary schools and grade 9 and 10 from middle secondary schools respectively. However, this gives a comparable idea of how representative the sample is in the student survey.
Table 4.3

The Number of Male-Female Students at Secondary Schools

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Secondary Schools</td>
<td>24,772</td>
<td>25,226</td>
<td>49,998</td>
</tr>
<tr>
<td>Middle Secondary Schools</td>
<td>19,665</td>
<td>20,298</td>
<td>39,963</td>
</tr>
</tbody>
</table>

Source: Annual Education Statistics (Policy and Planning Division, MoE, 2013)

Student Survey Participants by School Location

The Ministry of Education in Bhutan categorizes every school according to its location, and uses these seven categories: urban (grade 1 and grade 2), semi-urban, semi-remote, remote, very remote and difficult (Policy & Planning Division[PPD], 2013). However, there are no clear definitions in terms of schools and their locations. As a consequence, classifying a school as urban, semi-urban or rural is sometimes problematic. In this study, school location is deemed as significant because rural schools in Bhutan are usually constrained by material resources and many other facilities, whereas urban schools enjoy advantages in regard to materials and modern facilities including technology usage.

For the purpose of this study, schools are categorized as urban, semi-urban, and rural, and are narrowly and loosely defined. Urban schools are those schools that are located within a radius of approximately 5 km of the General Post Office (GPO) in Thimphu, the capital city of Bhutan. They are under the City Education Office, Thimphu. Semi-urban schools are those that are located within a 5 km to 10 km radius of the GPO, and in and around district centers of Paro and Thimphu. Rural schools are located 10 km and beyond, away from district centers. Most of them
barely have access to national highways, a few have some access to narrow feeder farm roads only, while still others do not have access to roads at all.

Table 4.4 describes the distribution of student samples by school location. It indicates that out of 608 participants, 251 (41.3%) of student participants were from urban schools, 156 (25.7%) from semi-urban schools, and 201 (33.1%) from rural schools. The representation from semi-urban schools is slightly smaller as compared to representation from rural and urban schools.

Table 4.4

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>251</td>
<td>41.3</td>
<td>41.3</td>
<td>41.3</td>
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<td>Semi-urban</td>
<td>156</td>
<td>25.7</td>
<td>25.7</td>
<td>66.9</td>
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<td>Rural</td>
<td>201</td>
<td>33.1</td>
<td>33.1</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>608</td>
<td>100</td>
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</tr>
</tbody>
</table>

The location of a school in remote a place greatly influences the way in which the teachers organize the learning environment for their students in the classrooms. It has always remained a challenge for field teachers to create conducive learning environment for their learners. Geographically, Bhutan is one of the most rugged, mountainous countries amongst the Himalayan countries. Many schools are located on slopes, or very close to river beds, and along the narrow valley, and so on. Hence, the school location seems to have a significant impact on the learning environment of those schools and classrooms. For instance, if schools are located in remote places, then it is really difficult to transport resources to them on time. This leads to poor facilities, and frustration and dissatisfaction among students and teachers who are working in these schools. If schools are located in urban areas, then they can enjoy better facilities and have advantages of using those modern amenities.
such as electricity, technology, electronic goods and so on, all of which adds to their physical well-being as well as psychological comforts.

4.2.2 Factor Structure, Reliability and Validity of the Student MCLES

Classroom learning environments are dynamic rather than static entities and differ from context to context, population to population, and time to time, and the research instrumentation needs to be continually reviewed (Dorman, Aldridge, & Fraser, 2006). Hence, it is necessary to validate context-specific instruments rather than simply use an instrument ‘off the shelf’ when conducting classroom environment research. Any survey instrument, whether newly developed or well established, needs to be reliable and valid for data collection. In the same vein, in order to resolve the issues concerning the validity of the student version of the MCLES questionnaire, the required statistical analyses were conducted, that is, subjecting the survey data to the process of reliability and validity testing, and factor analysis (Wahyudi, 2004).

Factor Structure of the Instrument

The questionnaire factor structure, internal consistency reliability, and discriminant validity of its various scales were used to address the issues concerning the instrument validity (Wahyudi, 2004). In order to understand the factor structure of the student version of the MCLES, principal component analysis followed by equamax rotation, was conducted for its 40 items using individual students’ mean scores as the unit of analysis. Five construct factors (scales) in the original WIHIC and three scales in the CLES were adapted for use in the study. The criterion used to retain items was that each of them must have a factor loading of at least 0.30, a conventionally-accepted minimum value to ensure factor loading for each scale as meaningful (Fraser, Aldridge & Adolphe, 2010; Wahyudi, 2004).
Table 4.5
Results of factor analysis for student version of MCLES questionnaire

<table>
<thead>
<tr>
<th>Item No.</th>
<th>TS</th>
<th>SC</th>
<th>TO</th>
<th>CO</th>
<th>EQ</th>
<th>CV</th>
<th>PR</th>
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<td></td>
<td></td>
<td></td>
<td>0.653</td>
<td></td>
</tr>
</tbody>
</table>

| % Variance | 5.95 | 6.46 | 6.15 | 5.26 | 6.76 | 6.41 | 5.75 | 6.69 |
| Eigenvalue  | 2.38 | 2.58 | 2.46 | 2.10 | 2.71 | 2.56 | 2.30 | 2.68 |

Note: Factor loading less than 0.30 can be omitted. The sample consisted of 516 grade eight students. TS: Teacher Support; SC: Student Cohesiveness; TO: Task Orientation; CO: Cooperation; EQ: Equity; CV: Critical Voice; PR: Personal Relevance; SN: Student Negotiation.
The results of principal component analysis are presented in Table 4.5, which shows that a majority of items in the questionnaire have a factor loading of greater than 0.30 on each of the eight MCLES scales. Hence, the instrument for this sample was accepted, but it required elimination of some items which did not load on the particular scales given.

Table 4.5 also presents the percentage of variance and eigenvalues for each scale of the MCLES. For the final factor structure, as given at the bottom of Table 4.5, approximately 49.41 % of the variance for could be accounted for by the eight factors, with the percentage of variance for the student version of MCLES ranging from 5.26 % to 6.76 % for different scales. The eigenvalues ranges from 2.10 to 2.76 for different scales of the student version of MCLES. Overall, the pattern of factor loadings provides a satisfactory support for the a priori structure of the MCLES indicating overlaps in some of its scales and items. This implies that there was a need for modification or removal of some of the questionnaire items (Item no.6 in the scale of Student Cohesiveness, Item no. 14 & 15 in the scale of Task Orientation, Item no.19 in the scale of Cooperation, and Item no.36 in the scale of Student Negotiation) in the instrument for the given sample.

Reliability of the Instrument

According to Landon (2011), the reliability of an instrument indicates how well a group of items are associated with one another, and the reliability of a scale indicates how free from random error the results are. The process of checking the internal consistency of the instrument ensures the degree to which the items that make up the scale are measuring the same underlying attribute. It is a statistic that measures reliability among a group of items combined to form a single scale, and reflects the
Homogeneity of the scale, meaning how well the different items complement each other in their measurement of different aspects of the same variable (Litwin, 1995). Hence, it is argued that “the reliability of a measure indicates the stability and consistency with which the instrument measures the concept and helps to assess the ‘goodness’ of a measure” (Cavana, Delahaye, & Senkaran, 2001, p. 210).

The Cronbach’s alpha coefficient was used as a measure of the internal consistency reliability of each scale of the research instrument, which was necessary to check for the extent to which each item in a scale measures the same construct (Ching-Tse, 2013). It is based on the average inter-item correlation (Chandra & Fisher, 2009). The reliability is usually expressed as a correlation coefficient (i.e., r value), between two sets of data (Litwin, 1995), and an acceptable criterion for the reliability of a commonly used scale is that it should have a Cronbach’s alpha coefficient of at least 0.60.

While some researchers believe that Cronbach alpha values above 0.70 is acceptable (e.g. Kline, 1999), others still have recommended that values above 0.60 are acceptable (e.g, Cavana, Delahaye, & Sekaran, 2000, in So & SWATMAN, 2010; Nunnally, 1967, in Chandra & Fisher, 2009). Cortina (1993 cited in Field, 2009) argued that “general guidelines need to be used with caution because the value of alpha depends on the number of items on the scale” (p.675). This is explained by the fact the value of alpha is directly proportional to the square of the items. Mathematically, the higher the number of items, the higher is the alpha value. In this case, scales with four items or less have a lower alpha value when compared to scales with 5 items. For this reason, others statistical measures were included. Factor analysis, and discriminant validity were also carried out which led to the conclusion that the student MCLES questionnaire was as an acceptable instrument for this study.
The Cronbach’s alpha coefficients for all eight scales of the MCLES for student perceptions of classroom learning environments are reported in Table 4.6 below.

**Table 4.6**

Scale-wise Reliability Test of Student MCLES questionnaire

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Alpha Coefficients</th>
<th>No. of Items</th>
<th>Valid cases(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Support</td>
<td>0.70</td>
<td>5</td>
<td>594</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>0.64</td>
<td>4</td>
<td>594</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>0.60</td>
<td>3</td>
<td>590</td>
</tr>
<tr>
<td>Cooperation</td>
<td>0.59</td>
<td>4</td>
<td>594</td>
</tr>
<tr>
<td>Equity</td>
<td>0.77</td>
<td>5</td>
<td>594</td>
</tr>
<tr>
<td>Critical Voice</td>
<td>0.72</td>
<td>5</td>
<td>598</td>
</tr>
<tr>
<td>Personal Relevance</td>
<td>0.69</td>
<td>4</td>
<td>601</td>
</tr>
<tr>
<td>Student Negotiation</td>
<td>0.73</td>
<td>5</td>
<td>594</td>
</tr>
</tbody>
</table>

When using the individual student as the unit of analysis, the alpha coefficient for the eight different scales ranged from 0.59 to 0.77. The highest alpha reliability coefficient was obtained for the Equity scale (α=0.77) and the lowest for the scale of Cooperation (α=0.59). The other internal consistency reliability coefficients lie between these values. The higher Cronbach’s alpha coefficients indicate the higher reliability of each item and more internal consistency among the items within a scale, whereas the lower Cronbach’s alpha indices mean the lower reliability and less consistency among the items. Since almost all of the Cronbach’s alpha coefficients were 0.60 and above, this fulfilled the criterion that is suggested above, except for the scale of cooperation. Hence, the MCLES questionnaire could be considered as a reliable instrument for this investigation. Thus, the results reported suggest that the classroom learning environment scales based on the MCLES were reliable when used with this sample of eighth grade students in Bhutan.
Validity of the Instrument

The validity of an instrument is the extent to which an instrument measures what it sets out to measure. For example, an item that is supposed to measure pain should measure pain and not some related variable such as anxiety, and a scale that claims to measure emotional quality of life should not measure depression, a related but different variable (Litwin, 1995). Reliability assessments are necessary, but they are not sufficient for examining the psychometric properties of a survey instrument. Once the reliability of a particular instrument is confirmed over time and in alternate forms, we must then make sure that it is reliably measuring the truth (Litwin, 1995). Hence, whether one is evaluating new survey instruments or applying established survey instruments to new populations, the validity must be ensured (Litwin, 1995), because it is an important measure of a survey instrument’s accuracy.

Different types of validity are measured when assessing the performance of a survey instrument, but for this study only three types of validity are considered, namely face, content, and construct validity. Face validity is based on a cursory review of items by untrained judges, involving simply showing one’s survey to a few untrained individuals to see whether they think the items look okay to them. It is a casual review of how good an item or group of items appear, and assessed by individuals with no formal training in the subject under study (Litwin, 1995). In this study, the face validity was ensured by administering the MCLES questionnaire to first year Bachelor of Education secondary pre-service teachers (n=16) of Paro College of Education, Paro Bhutan. They were requested to go through the questionnaires and give feedback in regard to the instrument’s appropriateness.
Once the questionnaires were collected, the researcher went through each of them and reviewed them carefully, and checked for accuracy. In general, there was no difficulty in completing MCLES questionnaire, but some of them were concerned about terms used as scales, like ‘Student Cohesiveness’ and ‘Student Negotiation’ in the questionnaire. The researcher explained the idea of adoption and use of these terms in this study, and why they cannot be replaced.

According to Litwin (1995), “Content validity is a subjective measure of how appropriate the items seem to a set of reviewers who have some knowledge of the subject matter” (p.35). In other words, it is a formal expert review of how good an item or series of items appear, and it is usually assessed by individuals with expertise in some aspects of the subject under study. Thus, in order to ensure the content validity of the instrument, feedbacks and suggestions given by the researcher’s supervisory team and confirmation panel members were carefully incorporated. It was suggested to remove some scales and items of the questionnaire, and accordingly scales such as Investigation, Attitudes and Communication were deleted. The total number of items in the questionnaire was also reduced from 60 to 40 items in the final version of the questionnaire. This was basically aimed to break the monotony among the participants while completing the survey questionnaires, and to encourage them to participate in the study.

Construct validity is a measure of how meaningful the scale or survey instrument is when it is used in practice. It often cannot be calculated as a quantifiable statistic, and it comprises of two other forms of validity: convergent and divergent. It is a theoretical measure of how meaningful a survey instrument is, and it is determined usually after years of experience by numerous investigators (Litwin, 1995). In this study, in order to validate the student MCLES questionnaire for its
constructs, the student survey data were subject to discriminant validity analysis of each scale of the MCLES. The discriminant analysis of validity for each of the MCLES scales involves using the mean correlation of a scale with the other seven scales as an index. Table 4.7 gives the mean correlation values for the eight MCLES scales.

Table 4.7

Mean Correlation of the Student MCLES questionnaire

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Mean Correlation</th>
<th>No. of Items</th>
<th>Valid cases(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Support</td>
<td>0.39</td>
<td>5</td>
<td>594</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>0.44</td>
<td>4</td>
<td>594</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>0.39</td>
<td>3</td>
<td>590</td>
</tr>
<tr>
<td>Cooperation</td>
<td>0.44</td>
<td>4</td>
<td>598</td>
</tr>
<tr>
<td>Equity</td>
<td>0.43</td>
<td>5</td>
<td>594</td>
</tr>
<tr>
<td>Critical Voice</td>
<td>0.40</td>
<td>5</td>
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<tr>
<td>Personal Relevance</td>
<td>0.41</td>
<td>4</td>
<td>601</td>
</tr>
<tr>
<td>Student Negotiation</td>
<td>0.44</td>
<td>5</td>
<td>594</td>
</tr>
</tbody>
</table>

The discriminant validity indices ranged from 0.39 for Teacher Support scale to 0.45 for the scales of Task Orientation, Student Cohesiveness, Cooperation and Student Negotiation, with the individual student mean as the unit of analysis (see Table 4.6). These indices are small enough to suggest that each scale of the MCLES has adequate discriminant validity even though some of them assess slightly overlapping aspects of classroom environment (Koul, 2003). However, these results confirmed the discriminant validity of the items in the MCLES questionnaire, since all the mean correlation coefficient (r) values were less than 0.80 (i.e., r ≤ 0.80), which met the required criterion of discriminant validity according to Brown (2006). Hence, the results reported suggest that the classroom learning environment scales based on the MCLES were valid when used with this sample of 8th grade students in Bhutan.
Further, the construct validity of the MCLES questionnaire in terms of its convergence and divergence can be confirmed based on the validation and use of the original version of the instrument. The MCLES was constructed based on the two existing classroom environment instruments: the What Is Happening In this Class (WIHIC) questionnaire (Aldridge, Fraser & Huang, 1999; Chionh & Fraser, 1998) and the Constructivist Classroom Learning Environment Survey (CLES) (Taylor et al., 1997). These two instruments have been the most robust and popularly used learning environment instruments for several decades now, and they were extensively field-tested and validated.

Since its initial development, the WIHIC has been successfully used by many researchers in various studies, and validated in numerous forms, different contexts and subject areas, in and around the world. For example, it has been used in studies in mathematics in Indonesia (Margianti, Fraser & Aldridge, 2001), in mathematics and geography in Singapore (Chionh & Fraser 1998; Chionh & Fraser, 2000), and in mathematics and science in Canada (Raaflaub & Fraser, 2002). Fraser, Aldridge, and Adolphe (2010) recently employed the instrument in a cross-national study of secondary science class environments in Australia and Indonesia. Murugan (2013) used its modified version to investigate students’ perceptions of mathematics classroom environments and mathematics achievement in Malaysia. Therefore, the WIHIC is an applicable and a flexible instrument that captures the holistic view of both teachers’ and students’ characteristics.

Similarly, the Constructivist Learning Environment Survey (CLES) (Taylor et al., 1997) had been employed in many studies. These include investigations on constructivist learning environments in a cross-national study in Taiwan and Australia (Aldridge, Fraser, Taylor, & Chen, 2000); assessment and investigation of
constructivist science learning environments in Korea (Kim, Fisher, & Fraser, 1999); and the relationship between students’ scientific epistemological beliefs and perceptions of constructivist learning environments (Tsai, 2000). Further, the instrument was used for the development of constructivist science classrooms and changes in student attitudes toward science learning in a Korean high school (Seok-Oh & Yager, 2004), and the investigation of students’ perceptions of mathematics classroom environments and mathematics achievement in Malaysia (Murugan, 2013). Thus, the CLES is a versatile instrument in the field of learning environment research.

4.2.3 Global Analysis of the Student Survey Data

In order to gain an overall perspective of student perceptions of mathematics classroom learning environments in Bhutanese secondary schools, the descriptive statistics, that is, mean (average item mean) and standard deviation (average item standard deviation) for each of the eight MCLES scales were computed. This was intended to provide the general views about the classroom environment in Bhutanese secondary mathematics classrooms as perceived by year 8 students. Then, in order to ascertain whether differences in perceptions of classroom learning environment exist, the descriptive statistics and other statistical analyses were conducted based on gender, school level and school location in the sections that follow.

The student participants responded to the MCLES on the basis of five-point Likert frequency scale responses of Never (1), Seldom (2), At times (3), Often (4), and Always (5). A response with a smaller number, say ‘Never’ (1), indicates the negative perceptions of students about their classroom environment, whereas a response with a larger number, say ‘Always’ (5), indicates positive perceptions of
students about their classroom learning environment. Table 4.8 provides the means and standard deviations for the student perceptions of each of the MCLES scales.

*Table 4.8*

Means and Standard Deviations for each scale of the MCLES

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Valid N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Support</td>
<td>3.85</td>
<td>0.79</td>
<td>594</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>4.03</td>
<td>0.67</td>
<td>594</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>4.19</td>
<td>0.69</td>
<td>590</td>
</tr>
<tr>
<td>Cooperation</td>
<td>4.05</td>
<td>0.73</td>
<td>598</td>
</tr>
<tr>
<td>Equity</td>
<td>4.28</td>
<td>0.73</td>
<td>594</td>
</tr>
<tr>
<td>Critical Voice</td>
<td>3.83</td>
<td>0.86</td>
<td>594</td>
</tr>
<tr>
<td>Personal Relevance</td>
<td>3.88</td>
<td>0.73</td>
<td>602</td>
</tr>
<tr>
<td>Student Negotiation</td>
<td>4.05</td>
<td>0.73</td>
<td>594</td>
</tr>
</tbody>
</table>

The Equity scale had the highest mean (M=4.28; SD=0.73) and the Critical Voice scale the lowest mean (M=3.83; SD=0.86) among all the scales. The means for all other scales were in between these values. These results suggest that across items in all the scales, students responded with either an ‘At times’ or ‘Often’ response. In other words, the means obtained for each of the MCLES scales was very close to four, which indicated that students perceived their classroom environments satisfactorily in terms of these scales. In general, low standard deviations were generated for each of the eight scales in the MCLES questionnaire, indicating that there were few outliers amongst the responses from the students – that is, most students’ responses did not markedly differ from those of the other students.

The students’ perceptions of their mathematics classroom learning environment in terms of each of the eight MCLES scales can be interpreted as
follows. For the purpose of discussion of the results under this section, the word ‘mean’ and ‘standard deviation’ are abbreviated as ‘M’ and ‘SD’ respectively.

a) Teacher support as a relationship dimension of the classroom learning environment refers to the extent to which the teacher helps, befriends, trusts, and is interested in his or her students (Aldridge, Fraser, & Huang, 1999; Dorman, 2008). In this study, there was an overall mean of 3.85 (SD=0.79) on the Teacher Support as a classroom learning environment scale (see Table 4.7). This result suggests that students on an average perceived their mathematics classrooms to have supportive teachers. Figure 4.2 below gives the mean and standard deviation for each item of the Teacher Support scale.

![Item Mean & SD for Teacher Support](image)

*Figure 4.2 Item mean & SD for student perception of Teacher Support*

The students believed that at times teachers took personal interest in them (Item 01, M=3.10, SD=1.37) and were caring (Item 04, M=4.19, SD=1.08). Teachers also went out of their way to provide them support (Item 02, M=3.46, SD=1.29). They also believed that the teachers helped them with their school work (Item 03, M=3.95, SD=1.14) because they wanted their students to do well (Item 05, M=4.54, SD =0.92). It can be noted that the
majority of students had positive perceptions about teacher support in their classrooms. It is interesting to note that the item number one from this scale has the lowest mean score (M=3.10, SD=1.37) among all the 40 items in the MCLES questionnaire.

b) Student Cohesiveness assesses the extent to which students know, help and support one another (Aldridge, Fraser, & Huang, 1999; Dorman, 2008). It is also a relationship dimension of the classroom psychosocial environment, that is, how each student is concerned about their support of their fellow classmates in their classroom. The mean for the Student Cohesiveness scale was 4.17 (SD=0.58), which indicates that most students gave ‘Often’ as a response for items in this scale. Figure 4.3 presents the mean and standard deviation for each item of the Student Cohesiveness scale.

![Item Mean & SD for Student Cohesiveness](image)

*Figure 4.3 Item mean & SD for student perception of Student Cohesiveness*

In this sample, the students believed that they were friendly to all other class members (Item 07-M=4.37, SD=0.85). They also got help from all of their classmates (Item 08-M=3.84, SD=1.04). They were also of the opinion that they worked well with all their classmates (Item 09-M=4.07, SD=0.94) and
helped their friends who had problems with their school works (Item 10- M=3.86, SD =1.02).

c) Task Orientation refers to the extent to which it is important to complete planned learning activities and to stay on the subject matter (Aldridge, Fraser, & Huang, 1999; Dorman, 2008). It is a personal growth dimension, which assesses the extent to which each student is concerned about their tasks at hand to complete them on time in the class. The overall scale mean for the student perceptions of Task Orientation was 4.28 (SD=0.58), indicating that most students gave a response of ‘Often’ or ‘Always’ for this scale. This result indicated that most students believed that they were completely task-oriented in their mathematics classrooms. Figure 4.4 gives the means and standard deviations for each item of the Task Orientation scale.

\[
\begin{array}{ccc}
\text{Item Mean & SD for Task Orientation} & \\
\text{Item 11} & 4.45 & 0.86 \\
\text{Item 12} & 4.02 & 0.94 \\
\text{Item 13} & 4.12 & 0.94 \\
\end{array}
\]

\[\text{Figure 4.4 Item mean & SD for student perception of Task Orientation}\]

The graphs in the figure above suggest that the students felt that it was important for them to complete given tasks on time (Item 11- M=4.45, SD =0.864) and they had to do as much as they can during lessons (Item 12- M=4.02, SD =0.40). They knew what they had to accomplish in class (Item
13-M=4.12, SD =0.94). It can be concluded that the students were satisfied with what they were doing in their mathematics class.

d) The Cooperation scale gives an idea of the extent to which students cooperate rather than compete with one another on learning tasks that are given to them (Aldridge, Fraser, & Huang, 1999; Dorman, 2008). This scale captures attributes of students’ performance as a team in given activities. The overall mean for the student perceptions of ‘Cooperation’ as a personal growth dimension of the classroom learning environment was scored as 4.13 (SD=0.63). Figure 4.5 gives the means and standard deviations for each item of the Cooperation scale.

Across the items in this scale, the students believed that they worked with other students towards achieving class goals (Item 16-M=4.27, SD =0.94) and were sharing their resources with other students when they were doing assignments (Item 17-M=3.95, SD =1.08). They also believed that there was a sense of teamwork when they worked in groups (Item 18-M=4.16, SD =0.98). They were also of the opinion that they learnt from each other in their mathematics classes (Item 20-M=3.93, SD=1.07).

Figure 4.5 Item mean & SD for student perception of Cooperation
e) The Equity scale assesses the extent to which students are treated equally by the teacher (Aldridge, Fraser, & Huang, 1999; Dorman, 2008; Koul & Fisher, 2005). This is one of the System Change and System Maintenance dimensions of the classroom psychosocial environment. The mean score for Equity as a scale of classroom environment was 4.29 (SD=0.73). This was the highest mean amongst all the MCLES eight scales indicating that students perceived this scale more satisfactorily than any other scales. Figure 4.6 gives the means and standard deviations for each item of the Equity scale.

![Figure 4.6 Item mean & SD for student perception of Equity scale](image)

Figure 4.6 Item mean & SD for student perception of Equity scale

Students’ responses suggested that they believed that they got the same amount of help (Item 21, M=4.29, SD =1.03) and encouragement (Item 24, M=4.36, SD =1.04) from their teacher as any other students in the class. They were of the opinion that they had the same amount of say (Item 22, M=4.02, SD =1.04), and an equal opportunity to contribute to class discussions as any other students (Item 25, M=4.41, SD=0.94). They also believed that they and other students in their class received equal treatment from their teacher (Item 23, M=4.34, SD =1.06).
f) The Critical Voice scale gives an indication of the extent to which a social climate has been established so that students consider it as legitimate and beneficial to question the teachers’ pedagogical plans and methods, and express concerns about any impediments to their learning (Aldridge, Fraser, Taylor, & Chen, 2000; Fisher & Khine, 2006; Taylor et al, 1997). It measures the personal growth of the individual student within the classroom environment. The mean value for the Critical Voice scale had been scored as 3.83 (SD=0.86), which is the lowest mean among all the eight scales of the MCLES. Given the nature of the student-teacher relationship across Bhutanese classes, this result is unsurprising. It is not the norm for students to question teachers, particularly in Bhutanese culture. Students always respect their teachers. Figure 4.7 gives the means and standard deviations for each item of the Critical Voice scale.

![Item Mean & SD for Critical Voice](image)

*Figure 4.7 Item mean & SD for student perception Critical Voice*

The results in the figure above suggest that the students believed that they could express their opinions (Item 30, M=4.00, SD=1.14) and question the way they were taught in the class (Item 27, M=3.86, SD =1.62). It was considered acceptable for them to ask the teacher for reasons for learning
certain things (Item 26, M=3.30, SD =1.46) in the class. Students felt that they could complain about activities that were confusing (Item 28, M=3.98, SD=1.24) and anything that prevented them from learning (M=4.00, SD =1.14). Item 26 –It's OK for me to ask the teacher “Why do I have to learn this?” has the second lowest mean (that is, M=3.30) among all the 40 items in the MCLES questionnaire. Further, in general, the scale has the lower means for all items as compared to other scales, which lead to the lowest mean among all the scales. This revealed that many of the students did not perceive ‘asking questions to their teachers’ positively.

g) The Personal Relevance scale focusses on how mathematics and students’ out-of-school experiences are connected, and how students make use of their everyday experiences as a meaningful context for the development of their mathematical and scientific knowledge (Fisher & Khine, 2006; Taylor et al., 1997). It is concerned with how mathematics content and skills are related to students’ real life experiences and beyond the four walls of the classroom. The mean for the student perceptions of Personal Relevance scale was 3.88 with a standard deviation of 0.73), which indicates that most students gave a response of “Often” for this scale. Figure 4.8 presents the means and standard deviations for each item of the Personal Relevance scale.

The results in the figure below suggest that students believed that they learnt about the world outside of school (Item 31, M=3.73, SD=1.20) and how mathematics could be part of their real life (Item 32, M=4.40, SD=0.89). They believed that what they had learnt in the class connected with their prior learning (Item 33, M=3.92, SD =0.968), and this knowledge enabled them to develop a better understanding of the world outside of their school (Item 34,
Further, they were of the opinion that they learnt interesting things about the life outside of schools in their mathematics class (Item 35, M=3.80, SD =1.18).

Figure 4.8 Item mean & SD for student perception of Personal Relevance

h) The Student Negotiation scale assesses the extent to which opportunities exist for students to explain and justify their newly developing ideas to other students, to listen attentively and reflect on the viability of other students’ ideas and, subsequently, to reflect self-critically on the viability of their own ideas (Aldridge, Fraser, Taylor, & Chen, 2000; Fisher & Khine, 2006; Taylor et al, 1997). It is one of the System Maintenance and System Change dimensions of the classroom learning environment. The mean score for this scale is 3.94 (SD=0.74), which indicates that most students gave the response of “At times” or “Often” indicating their positive perceptions of the scale. Figure 4.9 gives the means and standard deviations for each item of the Student Negotiation scale.

The results in the figure below suggest that most students believed that they had opportunities to talk with other students about how to solve problems (Item 37, M=4.12, SD =1.02). The students were of the view that they listened
to each other carefully (Item 40, M=3.58, SD=1.16). Further, they believed that they could explain their ideas to other students (Item 38, M=3.81, SD=1.07), and they could ask other students to explain their ideas to them (Item 39, M=3.78, SD=1.15).

Thus, the results of the descriptive statistics in general indicate that the student survey samples have had held favorable perceptions toward their mathematics classroom learning environments. Despite the overall favorable results, there are certain differences in their perceptions of classroom environment in terms of individual scales and items.

4.2.4 Student Perceptions of Classroom Environment based on Gender

Research findings in previous studies on gender and perceptions of classroom learning environments have proposed two key findings. While some studies have suggested that gender has no impact on students’ perceptions of their learning environments, other studies have reported otherwise. Earlier research has examined gender differences in students’ perceptions of their learning environment in order to understand why boys have outperformed girls in mathematics, science and
technology courses (Bellar & Gafni, 2000; Seopa et al., 2003). According to Seopa, Laugsch, Aldridge & Fraser (2003), earlier studies revealed that boys differ from girls in their perceptions of classroom learning environments. Kim, Fraser and Fisher (2000) found there were statistically significant differences between boys’ and girls’ perceptions of their learning environment on all seven scales of WIHIC in Korean secondary schools, where boys perceived Teacher Support, Involvement, Investigation, Task Orientation, and Equity scales more favorably than girls.

However, Tamir and Cariden’s (1993) finding of no gender-based differences in Israeli-Arabic students’ perceptions of the classroom environment contradicts most of the above research findings (Margianti, Fraser, & Aldridge, 2002). Similarly, a study by Khalil and Saar (2009) on students’ perceptions of classroom learning environment in Arab elementary schools did not reveal any significant differences between boys’ and girls’ perceptions of their classroom learning environment. This current study investigated the students’ perceptions of their classroom learning environment in terms of gender as one of the background variables. Table 4.9 reports on the means and standard deviations computed for each of the eight scales of the MCLES. These calculations were based on students’ gender. Table 4.9 also reports on the results of independent samples t-test and effect size (Cohen’s d) of the data for each scale of the MCLES.

The average item means of individual scales for males ranged from 3.77 (SD=0.86) for the Critical Voice scale to 4.29 (SD=0.71) for the Equity scale. The mean values of individual scales for females ranged from 3.82 (SD=0.77) for the Teacher Support scale to 4.31 (SD=0.62) for the Equity scale. Thus, the means across all the scales for males and females are clustered around 4. This suggests that most
students irrespective of their gender gave a response of “Often,” indicating that they perceived their classroom environments more positively.

Table 4.9

Mean, SD, t-values, and Effect Size for Student Perceptions of Classroom Environments by Gender

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (n=265)</td>
<td>Female (n=343)</td>
<td>Male (n=265)</td>
</tr>
<tr>
<td>TS</td>
<td>3.89</td>
<td>3.82</td>
<td>0.81</td>
</tr>
<tr>
<td>SC</td>
<td>4.02</td>
<td>4.04</td>
<td>0.68</td>
</tr>
<tr>
<td>TO</td>
<td>4.14</td>
<td>4.23</td>
<td>0.73</td>
</tr>
<tr>
<td>CO</td>
<td>4.03</td>
<td>4.12</td>
<td>0.68</td>
</tr>
<tr>
<td>EQ</td>
<td>4.29</td>
<td>4.28</td>
<td>0.71</td>
</tr>
<tr>
<td>CV</td>
<td>3.77</td>
<td>3.87</td>
<td>0.86</td>
</tr>
<tr>
<td>PR</td>
<td>3.85</td>
<td>3.90</td>
<td>0.75</td>
</tr>
<tr>
<td>SN</td>
<td>3.79</td>
<td>3.85</td>
<td>0.85</td>
</tr>
</tbody>
</table>

* p<0.05 is significant

Notes: TS: Teacher Support; SC: Student Cohesiveness; TO: Task Orientation; CO: Cooperation; EQ: Equity; CV: Critical Voice; PR: Personal Relevance; SN: Student Negotiation

There are small differences in the means (between male and female) across all MCLES scales. The result of the independent samples t-test (that is, t-test for equality of means) with the equal variances not assumed, showed that apart from the difference for the Cooperation scale (p<0.05), none of the other mean differences are statistically significant. This indicates that gender has little impact on their perception of their mathematics classroom learning environment. Thus, the outcomes of the independent samples t-test analysis of the data in this study found to be consistent with the findings of some of those past studies (Aldridge, Fraser, & Ntuli, 2009; Shadrek, 2012).
In order to estimate the magnitude of gender differences, further the effect sizes for each scale of the MCLES were calculated as recommended by many researchers (e.g., Thompson, 2001; Cohen, 1988, in MacLeod & Fraser, 2010). The effect size (d) is the difference between the means of male and female students’ perceptions of their classroom environment, expressed in standard deviation units, and it can be calculated by dividing the difference between two means by the pooled standard deviation (MacLeod & Fraser, 2010). Cohen (1988) cited in Schulze (2004) defined the effect size as small (d=0.2), medium (d=0.6), and large (d=0.8). These are used as a guide to evaluate the magnitude of a statistically significant difference. Effect size is independent of sample size, which is useful because sample size can influence the significance of test results (Hinton, 2004).

In this study, the effect sizes, using the individual student as a unit of analysis, ranged from 0.01 for the Student Cohesiveness and Equity scales to 0.10 for the Equity scale. The effect sizes for all eight MCLES scales in this study were small, that is, less than 0.2. This suggests that the magnitudes of gender differences were quite small and statistically not significant. These findings suggested that the perceptions of both male and female students about their mathematics classroom environment were comparable.

4.2.5 Student Perceptions of Classroom Environments based on School Level

Students’ perceptions of school level or grade level classroom environment have been researched in the past. Students’ perceptions of their actual and preferred school-level environments in South Africa (Aldridge, Laugksch, & Fraser 2006), and classroom climate in high school biology classrooms in Kenya (Mucherah, 2008) were investigated and statistically significant differences were found.
Hence, this study also tried to explore the student perceptions of the classroom learning environment in terms of school level, particularly at middle secondary and lower secondary schools in Bhutan. Descriptive analysis, comprising means and standard deviations was conducted to compare student perceptions of their mathematics classroom learning environment in terms of school level, that is, in middle secondary schools and lower secondary schools. These results are presented in Table 4.10.

### Table 4.10

Students' Perceptions of Classroom Learning Environments by School Level

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MSS</td>
<td>LSS</td>
<td>MSS</td>
</tr>
<tr>
<td>TS</td>
<td>3.75</td>
<td>3.95</td>
<td>0.83</td>
</tr>
<tr>
<td>SC</td>
<td>3.97</td>
<td>4.09</td>
<td>0.69</td>
</tr>
<tr>
<td>TO</td>
<td>4.22</td>
<td>4.26</td>
<td>0.72</td>
</tr>
<tr>
<td>CO</td>
<td>4.00</td>
<td>4.14</td>
<td>0.73</td>
</tr>
<tr>
<td>EQ</td>
<td>4.20</td>
<td>4.35</td>
<td>0.75</td>
</tr>
<tr>
<td>CV</td>
<td>3.78</td>
<td>3.87</td>
<td>0.85</td>
</tr>
<tr>
<td>PR</td>
<td>3.88</td>
<td>3.87</td>
<td>0.71</td>
</tr>
<tr>
<td>SN</td>
<td>3.78</td>
<td>3.86</td>
<td>0.82</td>
</tr>
</tbody>
</table>

*p<0.05 is significant

**Notes:** TS: Teacher Support; SC: Student Cohesiveness; TO: Task Orientation; CO: Cooperation; EQ: Equity; CV: Critical Voice; PR: Personal Relevance; SN: Student Negotiation

The mean values for student perceptions of classroom environment in middle secondary schools ranged from 3.75(SD=0.83) for the Teacher Support scale to 4.22(SD=0.61) for the Task Orientation scale, whereas the means of lower secondary school students’ perceptions of classroom environment ranged from 3.86 (SD=0.81) for Student Negotiation to 4.35 (SD=0.71) for the Equity scale. These results show that there is statistically not much difference in the means of students’ perceptions of
their classrooms in terms of these two school levels (lower secondary and middle secondary).

Independent samples t-test, (with equal variances not assumed) for the data in terms of school level was conducted (see table 4.7) in order to find differences in students’ perceptions. In the case of the scales of Teacher Support, Student Cohesiveness, Task Orientation, Cooperation, and Teacher Equity of the MCLES, the differences were found to be statistically significant at the \( p<0.05 \) level, but for the scales of Student Cohesiveness, Critical Voice, Personal Relevance, and Student Negotiation, the differences were not significant. Thus, the outcomes of the t-test of the data in this study seemed to be consistent with those of past research studies, meaning that school level seems to have some influence on the students’ perceptions about their mathematics classroom environment.

The effect sizes of the differences in the means, using the individual student as a unit of analysis, ranged from 0.01 for the Personal Relevance to 0.13 for the Teacher Support scale (see table 4.7 above). The effect size for all eight scales of the MCLES in this study was low (that is, less than 0.2). These findings also support the findings from the t-test analysis above, and suggest that the students’ perceptions about their mathematics classroom environment in both lower secondary and middle secondary schools were comparable.

4.2.6 Student Perceptions of Learning Environments based on School Location

Past studies (e.g., Huang, 2003; Shadrek, 2012) reported statistically significant differences in students’ perceptions of their classroom learning environments based on school location. This current study also examined the differences in student
perceptions of their mathematics classroom learning environments according to their school localities.

In order to explore differences in students’ perceptions of their classroom learning environments based on school location (i.e., urban, semi-urban, rural), the average item means and average item standard deviations were computed for each scale of the MCLES. Hence, as there are three categories of school location, the one-way ANOVA was deemed appropriate in place of independent samples t-test analysis. Table 4.11 shows the calculation of these scale means and standard deviations, as well as the one-way analysis of variance (ANOVA), that is, the F-ratios, which measure the extent of differences of between-group means on each scale of the MCLES.

Table 4.11
Means, Standard Deviations, & F-ratios for Student Perception of Classroom Environment by School Location

<table>
<thead>
<tr>
<th>Scales</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban (n=253)</td>
<td>Suburban (n=154)</td>
<td>Rural (n=201)</td>
</tr>
<tr>
<td>TS</td>
<td>3.75</td>
<td>3.93</td>
<td>3.92</td>
</tr>
<tr>
<td>SC</td>
<td>3.97</td>
<td>3.98</td>
<td>4.15</td>
</tr>
<tr>
<td>TO</td>
<td>4.19</td>
<td>4.22</td>
<td>4.18</td>
</tr>
<tr>
<td>CO</td>
<td>3.98</td>
<td>4.14</td>
<td>4.13</td>
</tr>
<tr>
<td>EQ</td>
<td>4.23</td>
<td>4.37</td>
<td>4.29</td>
</tr>
<tr>
<td>CV</td>
<td>3.69</td>
<td>3.83</td>
<td>3.99</td>
</tr>
<tr>
<td>PR</td>
<td>3.86</td>
<td>3.98</td>
<td>3.81</td>
</tr>
<tr>
<td>SN</td>
<td>3.72</td>
<td>3.87</td>
<td>3.91</td>
</tr>
</tbody>
</table>

* p<0.05 is significant

Notes: TS: Teacher Support; SC: Student Cohesiveness; TO: Task Orientation; CO: Cooperation; EQ: Equity; CV: Critical Voice; PR: Personal Relevance; SN: Student Negotiation
The scale means for student perceptions of classroom environments in urban schools ranged from 3.69 (SD=0.91) for the Critical Voice scale to 4.24 (SD=0.62) for the Task Orientation scale. The means for student perceptions of classroom environments in semi-urban schools ranged from 3.83(SD=0.84) for the Critical Voice to 4.37 (SD=0.59) for the Equity scale. Whereas, the means for student perceptions towards their classrooms in rural schools were scored ranging from 3.81 (SD=0.74) for Personal Relevance to 4.30 (SD=0.56) for the Task Orientation scale. This indicates that almost all the students responded with either an “At times” or “Often” response and their responses did not differ significantly in these three types of schools.

Thus, the descriptive analysis results revealed that though the student perceptions on all eight scales of the MCLES did not differ markedly according to the location of schools, there were some differences in their perceptions of the classrooms. The students in rural schools seemed to hold more favorable perceptions than the students in semi-urban schools, whereas the students from semi-urban schools perceived their classroom environment more positively than those students from urban schools. Further, in all three school localities, the scales of Teacher Support, Critical Voice, Student Cohesiveness, and Student Negotiation were perceived less positively as compared to the scales of Task Orientation, Cooperation, Equity, and Personal Relevance.

In addition, one-way between groups ANOVA with post-hoc comparison was carried out (see Table 4.10 above). When all eight MCLES scales were placed as dependent variables, and the school location as the determinant variable, the statistically significant differences only existed on the Teacher Support, Student Cohesiveness, and Critical Voice scales, while on the other five scales of the
MCLES, the differences were found statistically insignificant at the p<0.05 level. Hence, the outcomes of the ANOVA analysis in this study indicated that school location had certain influences on the students’ perceptions of their classroom learning environment.

4.2.7 Summary of the Student Survey Results

This section provides the summary of the results of the student survey (MCLES), which was administered as an adapted version of the two existing instruments (WIHIC and CLES). Bhutanese grade 8 students generally perceived their classroom environments favorably, but there existed certain differences in their perceptions on different scales of the MCLES. In general, the results of descriptive statistics revealed that both the boys and girls perceived the scales of Teacher Support, Student Cohesiveness, Critical Voice, and Student Negotiation less favorably compared to the scales of Task Orientation, Cooperation, Equity, and Personal Relevance.

Comparison of student perceptions of classroom learning environment based on gender shows that gender difference is not significant. However, the results of an independent samples t-test show significant gender differences on the scale of Cooperation, while there were no statistically significant differences in terms of gender on most of the MCLES scales.

The comparison of student perceptions of classroom learning environment based on school level shows that the mean values for student perceptions on almost all the MCLES scales were comparatively higher for lower secondary schools than for middle secondary schools. So, it is evident that students from lower secondary schools perceived their classrooms more positively than those from middle
secondary schools. However, the results of the descriptive statistics revealed that students from both the school levels perceived the scales of Teacher Support, Critical Voice, Personal Relevance, and Student Negotiation less favorably than the scales of Student Cohesiveness, Task Orientation, Cooperation and Equity. The independent samples t-test analysis indicated that the differences in students’ perceptions of classroom environments for the scales of Teacher Support, Task Orientation, Cooperation and Equity were statistically significant at the p<0.05 level, meaning that school level has influence on their perceptions of learning environment.

Lastly, the results on student perceptions of classroom learning environments based on school location show no differences in students’ perceptions of their classrooms. However, the results of descriptive statistics revealed that students from all three school locales perceived the scales of Teacher Support, Critical Voice and Student Negotiation less positively compared to the scales of Task Orientation, Cooperation, Equity, and Personal Relevance. It is interesting to note that the students from urban schools perceived their classrooms less favorably than their counterparts in rural and semi-urban schools. The results of one-way ANOVA indicate that the school location had significant influence on the scales of Teacher Support, Student Cohesiveness, and Critical Voice.

The results of the independent samples t-test and one-way ANOVA indicate the MCLES scales had statistically significant differences in terms of gender, school level and school location as presented below in Figure 4.10.

In terms of gender, only the Cooperation scale had statistically significant difference, meaning students’ perception of cooperation among themselves in the classrooms is significantly affected by their gender. The school level seemed to have
had greater influence on their perceptions of their classroom environments than gender and location, as it indicated by statistically significant differences on the scales of Teacher Support, Task Orientation, Cooperation, and Equity.

Figure 4.10 Representation of scales with statistically significant differences in terms of gender, school level and school location

The results of the one-way ANOVA results revealed that the school location also had statistically significant influence on students’ perceptions of their classroom environments in the case of the scales of Teacher Support, Student Cohesiveness, and Critical Voice. In the case of the scales of Personal Relevance and Student Negotiation, the three independent variables did not have a statistically significant effect.
4.3 Quantitative Data: Teacher Survey Results

This section presents the results of the teacher survey, that is, teacher perceptions of classroom learning environments, which pertains to the Research Question 2: *What are 8th grade teachers’ perceptions of their mathematics classroom learning environments in relation to the implemented new curriculum?* The survey was administered to eighth grade mathematics teachers to ascertain their views and opinions about their mathematics classroom learning environment.

4.3.1 Distribution of Teacher Survey Samples

The survey sample for teachers comprised 98 mathematics teachers from 22 lower secondary and middle secondary schools from the districts of Paro, and Thimphu in western Bhutan. The teacher participants responded to the teacher version of the Mathematics Classroom Learning Environment Survey (MCLES) questionnaire.

The sample (n=98) represents approximately 2.5% of the total population of 4,119 secondary school teachers against the national total of 8,530 teachers in Bhutan (National Statistics Bureau[NSB], 2013; Policy & Planning Division[PPD], 2013). Since the analysis of data had to be carried out based on three main independent variables – gender, school level, and school location, the distribution of samples were also presented separately in terms of these three variables. Thus, the teacher survey samples are discussed and presented accordingly.

**Distribution of Teacher Survey Participants by Gender**

Table 4.12 below shows the distribution of the teacher sample in the MCLES by gender, as compared to the national statistics given. Out of 98 teacher participants, 40 (40.8%) were males and 58 (59.2%) females. The male and female representation in the sample was almost equal. However, this may not indicate the actual scenario in
regard to the ratio of male to female mathematics teachers because in Bhutan most of
the mathematics teachers in secondary schools are male. In the absence of any
officially recorded data in regard to the male-female ratio of teachers in Bhutan, it
may not be out of place here to base it on anecdotal evidence. The ratio of male-
female teachers, particularly at the secondary school levels, can be estimated as 3:1.

Further, expatriate teachers particularly from India, dominate the field of
mathematics teaching in higher classes in schools and at the university level. The
sample represents approximately 1.8% of the male population of 2,231 secondary
school teachers, and 3.07% of the female population of 1888 secondary school
teachers, respectively.

\textit{Table 4.12}

Distribution of Teacher Survey Participants by Gender

<table>
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<tr>
<th></th>
<th>Survey Sample</th>
<th>National Statistics</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>Frequency</td>
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\textbf{Teacher Survey Samples based on School Level}

Table 4.13 below provides the distribution of teacher participants in the survey in
terms of school level – that is, lower secondary and middle secondary. In this study,
out of the total sample of 98 teachers, 50 (51.0\%) were from lower secondary
schools and 48 (49.0\%) from middle secondary schools. The representation of
teacher participants from both lower secondary schools and middle secondary
schools was almost equal. The teacher sample in this study represents approximately
2.4% of the total population of 2,114 lower secondary school teachers, and 2.5% of the total population of 2005 middle secondary school teachers, respectively.

*Table 4.13*

**Teacher Survey Participants based on School Level**

<table>
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<tr>
<th></th>
<th>Survey Sample Statistics</th>
<th>National Statistics</th>
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<tr>
<td>Total</td>
<td>98</td>
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</table>

**Sample of Teacher Participants by School Location**

As discussed earlier, the location of a school in a remote place greatly influences the way in which the teacher teaches and organizes the learning environment in the classrooms. It has always remained a challenge for the Ministry of Education to deploy teachers to those schools that are located in rural and remote places. Even with the introduction of the incentive system of difficulty allowance (difficulty allowance is an entitlement of extra financial benefits of those teachers who are posted to remote schools), many teachers do not opt to go to those schools. Hence, the school location or locality is deemed to have a significant impact on the social and psychological contexts of those schools and classrooms.

Table 4.14 below describes the sample of teacher participants in terms of school location (definitions as given earlier). It indicates that out of 98 teacher participants, 41 (41.8%) of them were from urban schools, 26 (25.5%) from semi-urban schools, and 31 (31.6%) from rural schools. The representation from semi-
urban schools is slightly smaller as compared to the representation from rural and urban schools.

Table 4.14
Teacher Survey Participants by School Location

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<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
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<td>Total</td>
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4.3.2 Factor Structure, Reliability and Validity of Teacher Version of MCLES

Though the scales of the teacher version of the MCLES were the same as the ones used in student version of the survey, the items of each scale had to be changed and modified further. In effect, the items had to be rewritten from the teachers’ point of view. Hence, once again the instrument had to be validated accordingly. The validity of an instrument or a scale can be described as the degree to which it measures what it is supposed to measure (Landon, 2011). The pilot test of the instrument was conducted by administering it to a group of seven mathematics teachers (n=7) in three selected schools (SC02, SC06 and SC01). The pilot testing of the instrument revealed that there was no problem in understanding and completing the questionnaire. However, the statistical test of reliability and validity was once again used to confirm and complement these findings. Accordingly, the teacher questionnaire data from the sample of 98 mathematics teachers were subject to factor structure, reliability and discriminant validity (mean correlation) analyses, because the level of confidence that the researcher can have in the results obtained from using any instrument depends on them (Landon, 2011).
Factor Structure of the Instrument

Using the MCLES questionnaire data obtained from 98 mathematics teachers, factor analysis was conducted to test the factor structure of the instrument. A principal components factor analysis followed by equamax rotation was conducted for the 40 items of the teacher version of MCLES using individual teachers as the unit of analysis. There are several techniques of carrying out factor analysis under principal component extraction, but the equamax rotation was found appropriate for this study as it provided the best results. Once again, five construct factors from the original WIHIC and three factors from the CLES were used in the study. The items of the instrument were retained based on the criterion that each item must have a factor loading of at least 0.30, in order to maintain its factor loading meaningful (Fraser, Aldridge & Adolphe, 2010; Wahyudi, 2004).

The results of principal component factor analyses are presented in Table 4.15, which provides the factor loadings for the teacher version of the MCLES. The results show that nearly all the 40 items have a loading of at least 0.30, which met the conventionally-accepted minimum criterion of factor loading on each item. This resulted in acceptance of the instrument for this teacher sample, but there was an indication for elimination of some items (Item no.16 from the scale of Cooperation, Item No.23 from the scale of Equity, and Item No.33 from the scale of Personal Relevance) in the questionnaire so that it becomes better instrument for use in the context of the given samples. However, overall the factor loadings of the 40 questionnaire items confirmed its internal factor structure with the omission of those items mentioned above from the consideration in the data analysis.
Table 4.15  Results of factor analysis for teacher version of MCLES

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<th>CO</th>
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<td>0.661</td>
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</tbody>
</table>

| % Variance | 6.13 | 7.27 | 9.60 | 7.50 | 6.16 | 8.93 | 7.17 | 8.60 |
| Eigenvalue  | 2.45 | 2.90 | 3.84 | 3.00 | 2.47 | 3.57 | 2.87 | 3.44 |

Note: Factor loading less than 0.30 were omitted. The sample consisted of 98 mathematics teachers. TS: Teacher Support; SC: Student Cohesiveness; TO: Task Orientation; CO: Cooperation; EQ: Equity; CV: Critical Voice; PR: Personal Relevance; SN: Student Negotiation
Table 4.15 also presents the percentage of variance and eigenvalue for each scale of the teacher version of MCLES. The eight MCLES scales together accounted for approximately 61.37% of the variance, with the percentage of variance for different scales ranging from 6.13 to 9.50%. The eigenvalues were greater than 1 for each of the eight factors, ranging from 2.45 to 3.84. Hence, the pattern of factor loadings on the whole provides satisfactory support for the a priori structure of the MCLES, though indicating overlaps in some of the scales. This implies the need for certain modification of items in the questionnaire based on the results of this factor analysis in order to make it usable for the given samples.

**Reliability of the Instrument**

As a part of statistical analysis, the Cronbach’s alpha coefficients for all eight scales of the MCLES were computed. In this study, since the data are cross-sectional, having three background variables of gender, school level, and school location, the individual teachers were taken as the unit of analysis. It is argued that use of the individuals as the unit of analysis can provide spurious results because an unjustifiably small estimate of the sampling error is employed in the test of significance (Dorman et al., 2004).

As stated earlier, the Cronbach alpha coefficient was used to assess the internal consistency of a scale, which is based on the average inter-item correlation (Chandra & Fisher, 2009). The calculation of these reliability alpha indices was reported in Table 4.16. The number of items in the scale and the strength of the correlation among the items determine the magnitude of alpha coefficient, whose values range from 0 to 1, with higher values indicating greater reliability and vice-versa (Landon, 2011).
Table 4.1

Reliability Test of Teacher MCLES Questionnaire

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<tr>
<th>Scales</th>
<th>Mean</th>
<th>SD</th>
<th>Cronbach’s Alpha</th>
<th>Unit of Analysis</th>
<th>N (List-wise)</th>
</tr>
</thead>
<tbody>
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<td>0.64</td>
<td>Individual</td>
<td>98</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>4.24</td>
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<td>0.79</td>
<td>Individual</td>
<td>98</td>
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<td>Task Orientation</td>
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<td>0.87</td>
<td>Individual</td>
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<td>Cooperation</td>
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<td>0.49</td>
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</tr>
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<td>Personal Relevance</td>
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<td>Individual</td>
<td>98</td>
</tr>
<tr>
<td>Student Negotiation</td>
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<td>0.84</td>
<td>Individual</td>
<td>98</td>
</tr>
</tbody>
</table>

The scale of Task Orientation had the highest Cronbach’s alpha index, that is, 0.87 with (M =4.12, SD=0.61), whereas, the Equity scale had the lowest value of Cronbach’s alpha coefficient of 0.60 with mean of 4.55 and standard deviation of 0.47. All other Cronbach’s alpha coefficients were in between these two values. Since the Cronbach’s alpha coefficients for all the scales were 0.60 and above, this fulfilled the criterion recommended by Nunnally (1967, cited in Chandra & Fisher, 2009). Hence, for the purposes of this study an alpha value of 0.60 was acceptable (For reasons explained in section 4.2.2 p.147) Hence, the teacher MCLES questionnaire could possibly be considered as an acceptable instrument for this study.

Validity of the Teacher Version of MCLES

The face validity was ensured by administering the MCLES to first year Bachelor of Education secondary pre-service teachers (n=16) of Paro College of Education, Paro Bhutan. Once the questionnaires were collected, the researcher went through each of them and reviewed them carefully to check how they had completed the questionnaires. It was observed that the pre-service teachers did not have difficulty in
completing the MCLES, except for the terms used as scales, like ‘Cohesiveness’ and ‘Negotiation’ in the questionnaire. The researcher explained the idea of adaptation and use of these terms in this study, and why they cannot be replaced.

The content validity of the teacher MCLES depended on the formal review of the instrument by the researcher’s supervisory team and confirmation panel members. Feedback and suggestions given were carefully incorporated and the instrument was updated. As with the student questionnaires, some scales and items of the questionnaire, such as Investigation, Attitudes and Communication, were deleted accordingly. The total number of items in the questionnaire was also reduced from 60 to 40 items in the final version of the survey questionnaire.

Lastly, in order to validate the teacher version of the MCLES questionnaire for its constructs, the data were subject to discriminant analysis of each scale of the MCLES questionnaire (that is, using the mean correlation of a scale with the other seven scales as an index). Table 4.17 below provides the mean correlation values for each scale of the teacher MCLES questionnaire.

Table 4.17
Mean Correlation of Scales of the Teacher MCLES Questionnaire

<table>
<thead>
<tr>
<th>Scales</th>
<th>Mean</th>
<th>SD</th>
<th>Mean Correlation</th>
<th>Unit of Analysis</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Support</td>
<td>4.30</td>
<td>0.52</td>
<td>0.40</td>
<td>Individual</td>
<td>98</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>4.24</td>
<td>0.50</td>
<td>0.35</td>
<td>Individual</td>
<td>98</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>4.12</td>
<td>0.61</td>
<td>0.37</td>
<td>Individual</td>
<td>98</td>
</tr>
<tr>
<td>Cooperation</td>
<td>4.26</td>
<td>0.49</td>
<td>0.45</td>
<td>Individual</td>
<td>98</td>
</tr>
<tr>
<td>Equity</td>
<td>4.55</td>
<td>0.47</td>
<td>0.25</td>
<td>Individual</td>
<td>98</td>
</tr>
<tr>
<td>Critical Voice</td>
<td>4.52</td>
<td>0.65</td>
<td>0.14</td>
<td>Individual</td>
<td>98</td>
</tr>
<tr>
<td>Personal Relevance</td>
<td>4.10</td>
<td>0.52</td>
<td>0.28</td>
<td>Individual</td>
<td>98</td>
</tr>
<tr>
<td>Student Negotiation</td>
<td>4.22</td>
<td>0.56</td>
<td>0.35</td>
<td>Individual</td>
<td>98</td>
</tr>
</tbody>
</table>
The mean correlation coefficients ranged from 0.14 for Critical Voice to 0.45 for the scale of Cooperation with the individual students as the unit of analysis (see Table 4.17) above). These indices suggest that the MCLES scales are distinct, but some of them tend to overlap each other. However, these results confirmed the discriminant validity of the items in the MCLES questionnaire.

4.3.3 Global Analysis of the Teacher Survey Data
After having found that the instrument met the criterion for its validity and reliability for the sample of 98 teachers, the mean and standard deviations for each of the eight MCLES scales were computed. This was intended to provide an overall perspective about the classroom learning environment in Bhutanese eighth grade mathematics classrooms as perceived by teachers. Further, in order to ascertain whether the differences in perceptions of classroom learning environment exist, the other statistical analyses were conducted based on the three background variables – gender, school level and school location – in the sections that follow.

Table 4.18 provides the average item means and standard deviations for perceptions of each of the MCLES scales by the teachers. Item means and standard deviations were calculated to portray the nature of the mathematics classroom environment in Bhutanese schools.

The Equity scale had the highest mean (M=4.55; SD=0.39), while the Personal Relevance scale had the lowest mean (M=4.01; SD=0.57) among all the scales. These results suggest that across items in all the scales, teachers responded with either a response of ‘Often’ or ‘Always.’ In other words, the means obtained for each of the MCLES scales were four and above, which indicated that teachers perceived their classroom environments positively in terms of these scales. The
standard deviation for all the eight scales in the teacher MCLES questionnaire were quite low, suggesting that there were few outliers amongst the responses from the teachers’ – that is, most teachers’ responses did not differ markedly from those of the other teachers. Teachers, in general, perceived a positive mathematics classroom learning environment in Bhutanese secondary schools.

Table 4.18
Mean and Standard Deviation of each scale of the Teacher MCLES

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Valid cases (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Support</td>
<td>4.30</td>
<td>0.52</td>
<td>98</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>4.24</td>
<td>0.50</td>
<td>98</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>4.12</td>
<td>0.61</td>
<td>98</td>
</tr>
<tr>
<td>Cooperation</td>
<td>4.26</td>
<td>0.49</td>
<td>98</td>
</tr>
<tr>
<td>Equity</td>
<td>4.55</td>
<td>0.47</td>
<td>98</td>
</tr>
<tr>
<td>Critical Voice</td>
<td>4.52</td>
<td>0.65</td>
<td>98</td>
</tr>
<tr>
<td>Personal Relevance</td>
<td>4.01</td>
<td>0.57</td>
<td>98</td>
</tr>
<tr>
<td>Student Negotiation</td>
<td>4.22</td>
<td>0.56</td>
<td>98</td>
</tr>
</tbody>
</table>

In addition to the above overall descriptive analysis, the individual item means and standard deviations were also calculated and analyzed. Hence, the teachers’ perceptions of their mathematics classroom learning environment in terms of each item of the MCLES scales can be interpreted as follows.

a) The overall mean for Teacher Support as a classroom learning environment scale was 4.61 (SD=0.39). This result indicates that most of the teachers were of the opinion that they gave good support to their students in their mathematics classrooms. Figure 4.11 gives the mean and standard deviation for the teacher perceptions of each item of the Teacher Support scale.
The teachers felt that they took personal interest in their students (Item 01, M=4.65, SD=0.54) and cared about what their students learned in the class (Item 04, M=4.76, SD=0.46). They went out of their way to help their students (Item 02, M=4.18, SD=0.83). They also thought that they helped their students with their school work (Item 03, M=4.59, SD=0.70) because they wanted their students to do well in schools (Item 05, M=4.87, SD =0.37). Hence, it is evident that the majority of the teachers were very satisfied with the support they gave to their students in their classrooms.

![Item Mean & SD for Teacher Support](image)

**Figure 4.11** Item mean & SD for teacher perceptions of Teacher Support

b) The mean of teacher perceptions for the Student Cohesiveness scale was 4.24 (SD=0.50), which indicates that most teachers responded with a response of “Often” for almost all items in this scale. Figure 4.12 presents the means and standard deviation for teachers’ perceptions of the Student Cohesiveness scale.

The graphs below show that the teachers believed that their students knew each other (Item 06, M=4.65, SD=0.58) and were friendly to each other (Item 07, M=4.45, SD=0.64). The students got help from one another in all their
works (Item 08, M=4.24, SD=0.66. They were also of the opinion that the students worked well with all of their classmates (Item 09, M=4.00, SD=0.72) and helped their friends who had problems with their school work (Item 10, M=3.86, SD=0.75).

![Item Mean & SD for Student Cohesiveness](image)

*Figure 4.12* Item mean & SD for teacher perceptions of Student Cohesiveness

c) The Task Orientation scale of the MCLES had the mean value of 4.12 (SD=0.61), indicating that most teachers gave either a response of “Often” or “Always” for this scale. This result indicates that most of the teachers believed that their students followed instructions and knew what to do about tasks given by teachers in their mathematics class. Figure 4.13 presents the mean and standard deviation values for teacher perception of each item of the Task Orientation scale.

The teachers felt that it was important for their students to complete the given tasks on time (Item11, M=4.16, SD=0.81) and they preferred that they did as much as they set out to do in the class (Item12, M=3.96, SD=0.67). They also believed that their students knew what they had to accomplish in their class (Item13, M=4.12, SD =0.94). They felt that their students understood their
works in the class (Item 14, M=4.44, SD=0.80) and they knew how much they had to do (Item 15, M=4.38, SD=0.83).

\[
\begin{array}{cc}
\text{Item 11} & 4.16 & 0.81 \\
\text{Item 12} & 3.96 & 0.73 \\
\text{Item 13} & 4.04 & 0.74 \\
\text{Item 14} & 4.26 & 0.70 \\
\text{Item 15} & 4.18 & 0.80 \\
\end{array}
\]

**Figure 4.13** Item mean & SD for teacher perception of Task Orientation

d) The mean for the teacher perceptions of ‘Cooperation’ as a personal growth dimension of the classroom learning environment was 4.26 (SD=0.49). Figure 4.14 gives the means and standard deviations for each item of the Cooperation scale.

\[
\begin{array}{cc}
\text{Item 17} & 4.24 & 0.67 \\
\text{Item 18} & 4.39 & 0.67 \\
\text{Item 19} & 4.3 & 0.74 \\
\text{Item 20} & 4.29 & 0.69 \\
\end{array}
\]

**Figure 4.14** Item mean & SD for teacher perceptions of Cooperation

Across the items in this scale, the teachers believed that their students were sharing their resources with other students when they were doing assignments.
(Item17, M=4.24, SD =0.67). They also believed that their students found a sense of teamwork when they worked in groups (Item18, M=4.39, SD =0.67). They were also of the opinion that the students knew how much work they had to do in the class (Item 20, M=4.30, SD=0.74) and cooperated with other students on many class activities (Item 19, M=4.29, SD =0.69). These results indicated that the teachers were extremely satisfied with the way their students cooperate in their mathematics class.

e) The mean score for Equity as a scale of classroom environment was 4.63 (SD=0.39). This was the highest mean amongst all the MCLES eight scales, indicating that the teachers had more satisfaction with this than any other scales. Figure 4.15 gives the means and standard deviations for each item of the Equity scale.

![Item Mean & SD for Equity scale](image)

*Figure 4.15 Item mean & SD for teacher perception of Equity scale*

Teacher responses in the sample suggest that they gave the same amount of help (Item 21, M=4.56, SD=0.83) and encouragement (Item 24, M=4.86, SD =0.43) to all of their students in the class. They were of the opinion that their students had the same amount of say (Item 22, M=4.10, SD=0.89), and the
equal opportunity to contribute to class discussions as any other students in the class (Item 25, M=4.68, SD=0.49).

f) The mean value for the Critical Voice scale was scored as 4.52 (SD=0.65). Given the nature of the student-teacher relationship across Bhutanese classes, this result is unsurprising. It is not the norm for students to question teachers, particularly in Bhutanese culture. Students generally believe that they should be obedient and respectful to their teachers. Figure 4.16 gives the mean and standard deviation scores for perceptions of each item of the Critical Voice scale by the teachers.

**Figure 4.16** Item mean & SD for teacher perception of Critical Voice

The results in the figure above suggest that the teachers believed that their students could express their opinions (Item 30, M=4.77, SD=0.53) and question the way they were taught in the class (Item 27, M=4.47, SD=0.84). They considered it acceptable for their students to ask them for reasons for learning certain things (Item 26, M=4.39, SD=0.80) in the class. They also viewed that students could complain about activities that were confusing
(Item 28, M= 4.48, SD=0.98) and anything that prevented them from learning (M=4.49, SD=0.84).

g) The mean for the teacher perceptions of Personal Relevance scale was 4.10 with standard deviation of (SD=0.52), which indicates that most teachers gave a response of “Often” for this scale. Figure 4.17 presents the means and standard deviations for teacher perceptions of each item of the Personal Relevance scale.

The results in the figure below suggest that teachers believed that their students learnt about the world outside of school (Item 31, M=3.98, SD =0.72) and how mathematics could be part of their real life (Item 32, M=4.35, SD=0.63). They believed that what their students had learnt in the class could enable them to develop a better understanding of the world outside of their school (Item 34, M=3.91, SD=0.79). Further, they were of the opinion that their students learnt interesting things about life outside-of-school in their mathematics class (Item 35, M=3.84, SD =0.80).

![Item Mean & SD for Personal Relevance](image)

*Figure 4.17 Item mean & SD for teacher perception of Personal Relevance*

h) The mean score for the Student Negotiation scale was 4.22 (SD=0.56), which indicates that most teachers gave a response of ‘Often’ and ‘Always.’
This gave an indication that most of the teachers had positive perceptions about the Student Negotiation scale. Figure 4.18 gives the means and standard deviations for each item of the ‘Student Negotiation’ scale.

The results in the figure above suggest that most of the teachers believed that there was a chance for their students to talk to other students in class (Item 36, $M=4.44$, $SD=0.69$). The teachers thought that their students had opportunity to talk with other students about how to solve problems (Item 37, $M=4.23$, $SD=0.70$), while the other students listened to them carefully (Item 40, $M=3.94$, $SD=0.78$). Further, they believed that their students could explain their ideas to other students (Item 38, $M=4.32$, $SD=0.70$), and they could ask other students to explain their ideas to them (Item 39, $M=3.94$, $SD=0.72$).

![Figure 4.18 Item mean & SD for teacher perceptions of Student Negotiation](image)

Overall, the results of the descriptive analysis of the teacher survey data showed that teacher participants in general viewed their mathematics classroom learning environments with 100% satisfaction. In addition, it was interesting to observe that teachers in Bhutan seemed to perceive their mathematics classrooms more favourably as compared to their year 8 students.
4.3.4 Teacher Perceptions of Learning Environments based on Gender

Although teachers are the main participants and observers of the educational process, not many past studies have examined teachers’ perceptions of their classroom environment. Studies on gender differences in teachers’ perceptions of classroom learning environment have been particularly limited in the past. However, some studies, such as the one by Huang and Fraser (2009), have examined science teachers’ perceptions of the school level environment and found statistically significant gender differences. In a recent study, Peer and Fraser (2015) also found sex differences in were statistically significant (p<0.05) for the four learning environment scales of Involvement, Teacher Support, Task Orientation, and Cooperation. This present study aimed to investigate the teachers’ perceptions of their mathematics classroom learning environment based on gender as a background variable.

Table 4.19 reports on the descriptive statistics (that is, average item means and average item standard deviations) computed for each of the eight MCLES scales. These calculations were based on teachers’ gender. The table 4.19 also reports on the results of the one-way ANOVA (F-ratios) of the data for each scale of the MCLES, which show the magnitude of differences in terms of their perceptions of each scale of the MCLES.

The average item means of the eight scales of the MCLES for males ranged from 3.95 (SD=0.59) for the Personal Relevance scale to 4.61 (SD=0.42) for the Equity scale. The mean values of the eight MCLES scales for females ranged from 4.06 (SD=0.59) for the Personal Relevance scale to 4.72 (SD=0.47) for the Teacher Support respectively. Thus, the means across all the scales for males and females are
clustered around 4 and above. This suggests that most teachers perceived their classroom learning environments favorably across the MCLES scales.

**Table 4.19**

Mean, Standard Deviation and F-ratios for Teacher Perception of Classroom Environments based on Gender

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (n=40)</td>
<td>Female (n=58)</td>
<td>Male (n=40)</td>
</tr>
<tr>
<td>TS</td>
<td>4.46</td>
<td>4.72</td>
<td>0.47</td>
</tr>
<tr>
<td>SC</td>
<td>4.17</td>
<td>4.29</td>
<td>0.47</td>
</tr>
<tr>
<td>TO</td>
<td>4.07</td>
<td>4.16</td>
<td>0.64</td>
</tr>
<tr>
<td>CO</td>
<td>4.22</td>
<td>4.36</td>
<td>0.49</td>
</tr>
<tr>
<td>EQ</td>
<td>4.61</td>
<td>4.51</td>
<td>0.42</td>
</tr>
<tr>
<td>CV</td>
<td>4.53</td>
<td>4.51</td>
<td>0.65</td>
</tr>
<tr>
<td>PR</td>
<td>3.95</td>
<td>4.06</td>
<td>0.59</td>
</tr>
<tr>
<td>SN</td>
<td>4.20</td>
<td>4.23</td>
<td>0.55</td>
</tr>
</tbody>
</table>

* p<0.05 is significant

Notes: TS: Teacher Support; SC: Student Cohesiveness; TO: Task Orientation; CO: Cooperation; EQ: Equity; CV: Critical Voice; PR: Personal Relevance; SN: Student Negotiation

Across all scales of the MCLES, there are small differences in the means of males’ and females’ perceptions of their classrooms. A one-way ANOVA showed that apart from the difference for the Teacher Support scale (p<0.05), none of the other differences are statistically significant. This indicated that gender has little impact on teachers’ perceptions of their mathematics classroom learning environment. Thus, the outcomes of the ANOVA analysis of the data in this study suggested that the magnitude of gender differences was quite small and educationally not significant. These findings suggest that the perceptions of both male and female teachers about their mathematics classroom environment were comparable.
To examine the magnitude of gender differences, as well as their statistical significance in terms of the mean values of teacher perceptions of classroom learning environments, the effect sizes were calculated in terms of the differences in means divided by the pooled standard deviation. The effect sizes for the scale of Teacher Support with statistically significant difference was recorded as -0.68. Further, the effect sizes for the other scales were also very low, that is, less than 0.20. This result suggested that there were educationally not significant differences in their perceptions of mathematics classrooms in terms of those eight MCLES scales.

4.3.5 Teacher Perception of Classroom Environment based on School Level

Teachers’ perceptions of school level or grade level classroom environment have been researched in the past. For instance, teachers’ perceptions of their actual and preferred school-level environments in South Africa (Aldridge, Laugsch, & Fraser, 2006), and classroom climate in high school biology classrooms in Kenya (Mucherah, 2008), were investigated and found to exhibit statistically significant differences. Similarly, this study also tried to explore the teacher perceptions of classroom learning environment in the context of school level. Specifically, it looked at middle secondary and lower secondary schools in Bhutan, where the same standard existed, and taught the same subject, the new mathematics curriculum.

The descriptive statistical analysis was conducted to compare teacher perceptions of classroom learning environment in terms of school level (lower secondary and middle secondary schools). The resulting means and standard deviations are presented in Table 4.20. The results of one-way analysis of variance (ANOVA) are also presented in Table 4.20.
The mean values for teachers’ perceptions of classroom environment in lower secondary schools ranged from 4.06 (SD=0.64) for the Personal Relevance scale to 4.66 (SD=0.35, SD=0.35) for the Teacher Support scale, whereas, the means for teachers’ perceptions of classroom environment in middle secondary schools ranged from 3.97 (SD=0.) for the Personal Relevance to 4.64 (SD=0.44) for the Critical Voice scale.

Table 4.20
Means, Standard Deviations and F-ratios for Teacher Perception of Classroom Environments by School Level

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LSS (n=50) &amp; MSS (n=48)</td>
<td>LSS (n=50) &amp; MSS (n=48)</td>
<td>F</td>
</tr>
<tr>
<td>TS</td>
<td>4.66</td>
<td>4.56</td>
<td>0.35</td>
</tr>
<tr>
<td>SC</td>
<td>4.26</td>
<td>4.23</td>
<td>0.52</td>
</tr>
<tr>
<td>TO</td>
<td>4.17</td>
<td>4.07</td>
<td>0.65</td>
</tr>
<tr>
<td>CO</td>
<td>4.35</td>
<td>4.26</td>
<td>0.57</td>
</tr>
<tr>
<td>EQ</td>
<td>4.59</td>
<td>4.51</td>
<td>0.50</td>
</tr>
<tr>
<td>CV</td>
<td>4.40</td>
<td>4.64</td>
<td>0.78</td>
</tr>
<tr>
<td>PR</td>
<td>4.06</td>
<td>3.97</td>
<td>0.64</td>
</tr>
<tr>
<td>SN</td>
<td>4.25</td>
<td>4.19</td>
<td>0.58</td>
</tr>
</tbody>
</table>

*p<0.05 is significant.

Note: TS: Teacher Support; SC: Student Cohesiveness; TO: Task Orientation; CO: Cooperation; EQ: Equity; CV: Critical Voice; PR: Personal Relevance; SN: Student Negotiation

To examine how significant the differences are between the means of teacher perceptions of their classroom environment in lower secondary and middle secondary schools, a one-way ANOVA was conducted. As a result of performing this one-way ANOVA, significant differences in teacher perceptions of Cooperation F(2, 98) = 3.93, p<0.05) and Critical Voice (F(2, 98) = 16.88, p<0.05) were observed with respect to their school level (i.e., lower secondary and middle secondary). Whereas in other scales of the MCLES the differences were found to be not statistically significant at the p<0.05 level, these findings suggest that the teachers’
perceptions about their mathematics classroom environment in both lower secondary and middle secondary schools were comparable. Thus, the outcomes of the ANOVA analysis of the data in this study seemed to be consistent with those of past research studies, meaning that the school level seems to have a certain influence on the students’ perceptions about their classroom learning environment.

To further examine the magnitude of differences in teacher perceptions of their classroom environment, as well as their statistical significance (as recommended by Thompson, 1998; 2001), effect sizes were calculated in terms of differences in means and divided by the pooled standard deviation. The effect size for Cooperation and Critical Voice, those two scales with statistically significant differences, were recorded as 0.10 and -0.38 standard deviations respectively. Even for the other scales, the effect sizes were recorded well below 0.20, which is interpreted as small (Cohen, 1988). These results suggest statistically significant differences between teachers’ perceptions of the classroom learning environments in lower secondary and middle secondary schools.

4.3.6 Teacher Perceptions of Classroom Environments based on School Location

The third line of comparison in this study was to examine the differences in teachers’ perceptions of classroom learning environment based on school location. For this, the means and standard deviations were computed for each scale of the MCLES. Table 4.21 below gives the calculation of these means and standard deviations, as well as the F-ratios, which tend to measure the extent of differences of between-group means on each scale of the MCLES.

As shown in Table 4.21 below, the scale means for teacher perceptions of classroom environments for urban schools ranged from 3.88 (SD=0.59; SD=0.49) for
the scale of Personal Relevance to 4.56 (SD=0.39) for the Teacher Support scale. The mean values for teacher perceptions in semi-urban schools ranged from 4.13 (SD=0.60) for the Personal Relevance scale to 4.73 (SD=0.43) for the Critical Voice. The mean scores for rural school teachers’ perceptions ranged from 4.11 (SD=0.56) for Personal Relevance to 4.73 (SD=0.28) for the Equity scale. This indicates that almost all the teachers irrespective of their school location responded to MCLES with a response of ‘Often’ and ‘Always.’ Their responses did not differ significantly in any of the three types of schools.

Table 4.21

Mean, Standard Deviation, F-ratios for Teacher Perception of Classroom Environments by School Location

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban (n = 41)</td>
<td>Semi-urban (n=26)</td>
<td>Rural (n = 41)</td>
</tr>
<tr>
<td>TS</td>
<td>4.56</td>
<td>4.70</td>
<td>4.61</td>
</tr>
<tr>
<td>SC</td>
<td>4.20</td>
<td>4.20</td>
<td>4.35</td>
</tr>
<tr>
<td>TO</td>
<td>3.99</td>
<td>4.14</td>
<td>4.28</td>
</tr>
<tr>
<td>CO</td>
<td>4.23</td>
<td>4.30</td>
<td>4.41</td>
</tr>
<tr>
<td>EQ</td>
<td>4.54</td>
<td>4.37</td>
<td>4.73</td>
</tr>
<tr>
<td>CV</td>
<td>4.44</td>
<td>4.73</td>
<td>4.45</td>
</tr>
<tr>
<td>PR</td>
<td>3.88</td>
<td>4.13</td>
<td>4.11</td>
</tr>
<tr>
<td>SN</td>
<td>4.13</td>
<td>4.28</td>
<td>4.30</td>
</tr>
</tbody>
</table>

* p<0.05 is significant

Notes: TS: Teacher Support; SC: Student Cohesiveness; TO: Task Orientation; CO: Cooperation; EQ: Equity; CV: Critical Voice; PR: Personal Relevance; SN: Student Negotiation

These descriptive analysis results revealed that the majority of teachers, irrespective of the school localities, perceived their classroom environments positively across all scales of the MCLES. However, one of the notable observations is that the teachers in rural schools perceived their classrooms more favorably than those who were from semi-urban and urban schools. This result contradicts the
general assumption that urban schools have better facilities in comparison to rural schools, and that teachers should be positive about their classrooms.

To examine whether the differences were statistically significant, further one-way between-groups ANOVA with post-hoc comparison was carried out (see Table 4.18). All eight scales of the MCLES were placed as dependent variables, whereas the school location was placed as the independent variable. When the school location was used as an independent variable, the statistically significant differences only existed on the Equity scale ($F(3, 98) = 4.27, p<0.05$). For all other scales of the MCLES, the differences were found to be not statistically significant at the $p<0.05$ level. These findings suggest that the teachers’ perceptions of their mathematics classroom environment in urban, semi-urban, and rural schools were not comparable for the equity scales. Thus, the outcomes of the ANOVA analysis of the data in this study seemed to be inconsistent with those of past research studies, meaning that school location seems to have had little influence on teachers’ perceptions towards their classroom environments.

4.3.7 Summary of Teacher Survey Results

The overall analysis of the teacher survey data using the descriptive statistics revealed that the teachers’ perception of their classroom learning environments was very positive. The mean scores for all eight scales of the MCLES were mostly 4 and above, indicating that most teachers responded to each item either with a response of ‘Often’ or ‘Always.’ This shows that teachers were very satisfied with their mathematics classroom environments. The results of the descriptive analysis showed that though gender seemed to have very little impact on their perceptions of classrooms, the female teachers perceived their classrooms more favorably than their
male counterparts. The means on the scales of the MCLES were comparatively higher for the females (M=4.12 to 4.72) than for the males (M=4.07 to 4.46).

The findings on comparison of teachers’ perceptions of classroom environments in terms of school level indicated that there were no significant differences in their perceptions. The means for all eight scales of the MCLES were recorded as 4 and above. However, the results revealed that the teachers from lower secondary school perceived almost all scales of the MCLES more favorably than those teachers from middle secondary schools. This indicates that the school level does have a certain influence on teachers’ perception of their classroom environments.

The results of the statistical analysis comparing teachers’ perceptions of classroom environments in terms of school location indicated that there was no statistically significant difference in teachers’ perceptions of their classrooms. The means for all scales of the MCLES were clustered around 4, while the standard deviations generated were low, indicating not many extreme values in the data set. However, the findings revealed that teachers from rural schools perceived their classrooms more favourably than those from semi-urban schools; while the teachers from semi-urban schools perceived their classrooms more positively than those from urban schools.

As represented in Figure 4.19, comparing the teachers’ perceptions of their classroom environments in terms of these three background variables (gender, school location and school level), these factors seem to have had no influence on the teachers’ perceptions of the Student Cohesiveness, Cooperation, Personal Relevance and Student Negotiation scales. Gender difference was significant on the teachers’
perception of Teacher Support and Critical Voice scales; school level had significant influence only on Task Orientation and Critical Voice scales; whereas school location has significant influence on the Equity scale of the MCLES.

Figure 4.19 Representation of scales with statistically significant differences in teacher perceptions of classroom environment in terms of gender, school level and school location

4.4 Comparison of Students’ & Teachers’ Perceptions of Learning Environment

In order to have an overall perspective of the quantitative data collected, the overall means and standard deviation for each of the eight scales of the MCLES were calculated for comparison of students and teachers’ perceptions of classroom environments (see Figure 4.20 below). The mean scores for students’ perceptions of classroom learning environment ranged from 3.83 for the Critical Voice scale to 4.29 for the Equity scale. On the other hand, the means for teachers’ perceptions of classroom environment ranged from 4.10 for the Personal Relevance scale to 4.63 for
the Equity scale. Hence, the descriptive statistics revealed that both students and teachers mostly responded with a response of ‘Often’ and ‘Always’ to the MCLES Likert scales’ items. No outliers were observed in any of the data sets.

In order to ascertain whether differences existed based on gender, school level and school location on the students’ and teachers’ perceptions of their mathematics classroom learning environments, Likert data derived from all participants’ responses to the MCLES instrument were subject to either one-way ANOVA or effect size analyses. The results of these analyses showed that these three variables have had significant influence on eighth grade students’ and teachers’ perceptions of some scales of the MCLES only. Figure 4.20 below gives the overall comparison of mean values for student and teacher perceptions of classroom environments.

![Means of Student & Teacher Perceptions of CLE](image)

*Figure 4.20 Comparison of means for student and teacher perceptions*

It is apparent from the graph above that on the whole there was no statistically significant difference in their perceptions of the mathematics classrooms. However, it is indicative of the fact that comparatively the teachers seemed to hold
better perceptions of their classroom learning environments than their students did, and these results are comparable with the findings of past research (B.J. Fraser, 1998a, 2001). The graph above shows the comparison of the means of students and teachers’ perceptions of their classroom learning environment. The survey results reveal that the teachers perceived their mathematics classrooms more favorably than their students. This is evident from the higher means for most of the scales for teacher perceptions than for student perceptions of their classroom environments. The following are the overall findings which can be drawn from the survey data analyses.

First, both the students and teachers’ perceptions about their mathematics classrooms were positive and there was not much statistical difference in their perceptions. However, comparing the means of the MCLES scales as shown in the graph above, these mean values were generally higher for teachers than students. In terms of gender, the descriptive statistics revealed that both the female teachers and girls perceived their classrooms more favorably than their male counterparts. Further, the results of independent samples t-test and one-way ANOVA analyses indicated that gender has statistically significant influence on the students’ and teachers’ perceptions of classroom environment respectively on the Teacher Support scale.

The results also indicated that both the students and teachers from lower secondary schools perceived their classrooms more satisfactorily than those students and teachers from middle secondary schools. Finally, students and teachers from rural schools seemed to hold more favorable perceptions of their classrooms than their counter-parts from semi-urban and urban schools, while semi-urban school students and teachers still perceived their classroom environments better than those urban school students and teachers.
4.5 Chapter Summary

The chapter reported on the findings from the analysis of the data gathered during Phase 2 of the research study. The results of the quantitative data analyses showed that there was no significant difference in teachers’ and students’ perceptions of their mathematics classroom environments as a whole, although they perceived their classrooms positively. However, differences existed in terms of their perceptions of individual scales of the MCLES questionnaire.

Descriptive statistics showed that teachers generally held more favorable perceptions on the scales of Teacher Support, Equity, and Critical Voice than the other five scales of Student Cohesiveness, Cooperation, Critical Voice, Personal Relevance, and Student Negotiation. Students on the other hand, perceived the scales of Teacher Support, Critical Voice, Personal Relevance, and Student Negotiation less favorably than the other four scales of Student Cohesiveness, Task Orientation, Cooperation and Equity. So, there exist certain differences in students’ and teachers’ perception of their classroom learning environments across the eight scales of the MCLES.

The findings from the Phase 2 study, the quantitative survey, are summarized as shown in Table 4.22. It was argued that the mathematics classroom environment is an important variable to determine student achievement (Murugan, 2012), and the effective implementation of the curriculum. Hence, it is imperative to investigate the students’ and teachers’ perceptions of classroom environment, so that student learning outcomes can be improved.

The findings of the quantitative data indicated that the three independent variables (gender, school level, and school location) have certain influences on students and teachers’ perceptions of their classroom environments. However, the
A statistically significant gender difference was found on students’ perceptions on the scale of Cooperation only, and teachers’ perceptions of the scale of Teacher Support and Critical Voice.

School level has statistically significant differences in students’ perception of the scales of Teacher Support, Task Orientation, Cooperation and Equity, and in teachers’ perceptions of the scales of Task Orientation and Critical Voice.

School location has statistically significant difference in students’ perceptions of the scale of Teacher Support, Student Cohesiveness, and Critical Voice, and on teachers’ perceptions of the Equity scale only.

Table 4.22 below provides a summary of the quantitative data results. Tick mark () in each box of Table 4.22 shows the statistically significant result for each of the eight MCLES scales in terms of gender, school level and school location.

Table 4.22

<table>
<thead>
<tr>
<th>MCLES Scales</th>
<th>Students</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gender</td>
<td>Level</td>
</tr>
<tr>
<td>Teacher Support</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Cooperation</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Equity</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Critical Voice</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Personal Relevance</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Student Negotiation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 5: Qualitative Data Results

5.1 Introduction

This chapter reports on the findings from the qualitative data, which were gathered during Phase 3 of the research project. This phase of the study involved the collection of qualitative data in order to provide further evidence to support the validity of the findings from the quantitative data and to determine the contextual factors that influence the mathematics classrooms in Bhutanese schools. The findings from the qualitative data analysis are reported in two parts: Validation of the findings from quantitative data, and emerging contextual factors affecting the mathematics classroom learning environment.

According to Koul (2003), researching schools and classrooms with the use of a mixed-methods approach has provided a new direction for research in science and mathematics education. It leads not only to data triangulation (Anderson, 2004), but also helps in examining the construct validity of the research instrument and in-depth understanding of learning environments from more than one perspective (B.J. Fraser, 1998b). In this study, data collection involved both the administration of surveys to quantitatively assess students’ and teachers’ perceptions of the mathematics classroom learning environment, and the qualitative interviews to help expand the scope, depth and credibility of the study (Peer, 2011). Yardley and Marks (2004) suggested that semi-structured interviews should be based upon an interview schedule with typically 5-8 main questions, along with probes to supplement them if respondents have difficulty in elaborating their perspectives. They were of the view that semi-structured interviews should allow the respondents to freely express their
views and feelings about a subject. For this reason, the study also employed the interview schedules for each group of respondents separately.

The interview process involved certain careful measures to ascertain the construct validity of the instrument, and enhance the validity of the findings. The researcher tried as much as possible to conduct the interviews in a quiet place that was free from distractions and noise of surrounding students. According to Peer (2011), in order to ensure that interviewees are at ease when sharing their views, the researcher should engage in active listening to interviewees’ conversations and allow them to comment freely without agreeing or disagreeing with them. The researcher tried to create a friendly atmosphere using positive nonverbal cues such as using non-intimidating body posture and maintaining eye contact at all times. In addition, as recommended by Matheson (1998), the various interviews took place at different times, locations, dates and at the convenience of the participants. Hence, the construct validity of the survey questionnaires as well as the interview questions were complemented, and the findings of the study could be further validated.

However, although there were three case study schools from which the interview data were collected, the data for three cases were not analysed and reported separately, as there was limited time at the disposal of the researcher during the data analysis stage. In addition, the study was constrained by the complexity of the data triangulation – quantitative and qualitative data as a whole, teacher and student surveys, teacher and student interviews, comparison of student survey data by gender, school level, and school location, and comparison of teacher survey data by gender, level and location. Hence, the cross-case analysis (Koners & Goffin, 2007; Stronge, Ward, & Grant, 2011) was deemed appropriate for the present study, whereby the combined results are presented rather than a case-wise analysis. Figure
5.1 below presents the overall procedure of the conduct of interview analysis, in which student interviews and teacher interviews were triangulated to provide the combined results of the data.

**Figure 5.1** Overview of qualitative data analysis

### 5.2 Interview Samples

Qualitative data were mainly gathered in the form of interviews. A sample of 31 grade 8 students (who were divided into six focus groups), and five mathematics
teachers from three case study schools (SC02, SC06, & SC13), were interviewed. Hence, a total of 11 semi-structured interviews, which included six student focus group interviews, and five teacher face-to-face interviews were held altogether. Interview protocols for students and teachers were developed based on the survey questionnaire. The student interviews were conducted in a group setting, which included the four to six interviewees and the researcher, whereas the teacher interviews were conducted individually in a face-to-face situation. The interviewees were made to feel comfortable during the entire process, and they understood that their responses would remain anonymous. In order to capture all conversations and to make the data analysis easy later, both the student and teacher interviews were audio recorded, processed and transcribed accordingly.

The interviews were conducted only in three selected case study schools, namely, SC02, SC06, and SC13. Two of these schools are located in semi-urban areas (SC02 & SC06) and only one is located in an urban area (SC13). It was found difficult to include rural schools in the case study, mainly due to the issue of accessibility to schools and other risk factors involved for the researcher during the time of research data collection. Hence, the school SC06, which is the furthest from the district centres among the three selected schools, was taken as the representative of the rural schools for the purpose of the study. Schools in Bhutan are considered as rural or urban simply by their accessibility to motorable road ways and by their distance from the district centres or towns.

Teacher participants volunteered to participate in the study on their own, while student participants were nominated by their subject teachers based on their willingness and interest to participate. Students and teachers were interviewed to get their differing perspectives about their mathematics classrooms. Table 5.1 presents
the description of interview samples by gender, school level, and school location. Most of the interview participants were also the respondents to the survey questionnaires. However, their interview responses could not be cross-referenced with their survey responses, mainly owing to the issue of maintaining individual participants’ anonymity.

Table 5.1
Samples of Teacher and Student Interview Participants

<table>
<thead>
<tr>
<th>Location/Level</th>
<th>Students Male</th>
<th>Students Female</th>
<th>Teachers Male</th>
<th>Teachers Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC02 (Semi-urban LSS)</td>
<td>3</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>SC06 (Rural MSS)</td>
<td>4</td>
<td>11</td>
<td>2</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>SC13 (Urban LSS)</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total Interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>36</td>
</tr>
</tbody>
</table>

The next two sections present the results of the qualitative data based on the student focus group interviews and teacher face-to-face interviews. Section 5.3 focusses on the presentation of results based on both the students and teachers’ views on the eight scales of the classroom learning environment relating to key factors which influence each of them. Section 5.4 examines the other contextual factors, which are affecting the mathematics classroom environments in Bhutanese schools.

5.3 Validation of the Findings from Quantitative Data

This section presents the interview data on student and teacher perceptions of classroom learning environments in Bhutanese secondary schools. The data were collected from both student and teacher interviews in an effort to validate the findings from the quantitative data. These interview data helped the researcher in explaining the construct validity of the MCLES. The analysis of interview data firstly
involved the researcher drawing on an understanding of the participants’ responses to the MCLES in relation to certain key contextual factors, which consequently affect the effectiveness of curriculum implementation in Bhutanese schools. This was intended to validate the findings from the survey in regard to each scale of the MCLES and link them with the findings from the interview data. Hence, those key factors that had an influence on each of the eight scales of the MCLES were grouped accordingly and discussed under the following eight categories: Teacher Support and student enthusiasm; Student Cohesiveness and peer support system; Task Orientation and nature of work; Cooperation and group work; Equity and teacher professional ethics; Critical Voice and students’ respect for the teacher; Personal Relevance and students’ attitudes; and Student Negotiation and competition.

As suggested by Aldridge, Fraser, Taylor and Chen (2000) and Koul (2003), the interview data have been grouped by each scale of the MCLES as primary data gathering tools. This process can be defined as “triangulation of scales with qualitative analysis of classrooms” (Ryan & Patrick, 2003, p. 21). Thus, the validation of the results of quantitative data using interview data will be discussed taking into account those eight constructs (scales) of the MCLES, along with their corresponding eight key factors or variables, which tend to influence these scales within the given classroom contexts.

5.3.1 Teacher Support and Student Enthusiasm

This scale is meant to ascertain the extent to which the teacher helps, relates to, trusts and shows interest in his or her students (Landon, 2011; Peer, 2011). Hence, when the students perceive a teacher to be approachable and interested in them, they are more likely to seek the teacher’s help if there is a problem with their work (Velayutham, 2012). Both student and teacher interview results supported the very high mean
scores for the scale of Teacher Support. The findings from the quantitative data indicate that the majority of the students perceived the scale of Teacher Support (mean=3.85) favorably, and the teachers themselves (mean=4.61) were comparatively more positive than their students about this scale (see table 4.5 & 4.9).

Focus group interviews with the students indicated that they perceived their mathematics classroom environments to be highly teacher supportive. They felt that they received adequate support and expressed no concern about approaching their teachers. Many of the comments made by the student interviewees revealed that they generally believed their mathematics teachers were supportive. For example, they commented that when they encountered difficulties, the teachers were very willing to assist them. Sometimes this support was also forthcoming from teachers other than their mathematics teachers. At times when students were stuck with their class work, such as solving problems, the teachers went around and ensured they solved them correctly and completed their tasks on time. These students’ perceptions about teacher support are reflected in the following comments.

Our mathematics Sir (teacher) supports us very much. If we have a problem, he just comes to us and explains problem with us. (Student: Lhawang, SC02/G2)

Sir, we get a lot of support from our math teacher when we don’t know the questions, and also from other teachers, Sir. (Student: Dorji, SC06/G5)

Teacher interviews suggested that perceptions of this dimension of the MCLES could be influenced by the degree of student enthusiasm and interest they show in learning mathematics. When students are enthusiastic and interested in learning, teachers too are motivated to work hard and support them. Some of the teachers felt that supporting students in the Bhutanese school situation was a
challenge, even if they wanted to. The challenge was that some of their students were unenthusiastic and unwilling to come forward with their queries. Even when teachers invited them to their place if they had problem to extend support to their students, the response was generally poor. This difficulty was explained by a teacher as follows.

*I want to give them the support. So, ‘I have collected, even the question papers, past question papers for so many years, and since I am taking computer, I have put them in all the computers.’ But, other than the IT students, I don’t see any of them coming to the lab. They are not going through those questions also. They are least bothered. (Teacher: SC06/205).*

Some other teachers were of the opinion that those students who were academically talented always come forward to seek support from the teacher, whereas those who are weak and below average, do not come forward to seek support. In order to create such an opportunity for those low achievers, they tried to go to their groups and support them. This is evident from the following comment made by one of the teacher interviewees (T203) as follows:

*Those who are bright students they know also, but when they have doubt they also come forward and ask. But those who are very weak students, they don’t usually come forward, and they don’t ‘clarify’ their doubts. For that to give the opportunity I am going to their groups and just giving support to each and every student, especially to the weaker students. (Teacher: SC02/ T203)*

This result indicated that the teachers’ willingness and enthusiasm to support their students are directly associated with their students’ enthusiasm and willingness to come forward to seek support from them, which otherwise may act as a demotivating factor in their behaviours. Thus, it can be concluded that student enthusiasm can affect teacher support towards their students, and it all depends on
how the students take advantage of their teachers being supportive and interested in
their learning.

According to Afari, Aldridge, and Fraser (2011), “The supportiveness of a
teacher helps to give students the courage and confidence needed to tackle new
problems, take risks in their learning, and work on and complete challenging tasks”
(p.1383). Hence, the teachers’ support provides their students a lot of encouragement
and confidence to do the things at hand, and, given the support, they try to complete
even challenging tasks. Students give examples of teachers teaching them again and
again, until they all could understand the concepts and skills in particular topics. This
point is substantiated by the following comment made by one of the students:

I think our Sir and our friends are supportive, they are really supportive. Because, for me, whenever I have hard time doing some practical, then I just ask my sir, he explained us again and again, until all the students are, like say, perfect in it. (Karma, SC02/G1)

Some teachers were also of the view that though they wanted to give their
support to their students, at times, due to lack of resources and teaching-learning
materials, they were not able to give them appropriate and effective support. One of
the teacher participants pointed out:

I try to give all my best, but then there are also hurdles, which provide
hindrances to our teaching. These are like thing, unavailability of teaching
resources. And sometimes, we come across situations where we are not able
to give the print outs, which is being provided in CD Rom. Especially, in
remote schools we face lot of printing problems, Sir. (Teacher: SC02/T201)

These interview results indicated that the students held comparatively more
positive perceptions about the Teacher Support scale than their teachers. Teachers
were not satisfied with the way that the students sought support from them. Some of the possible reasons, which need to be highlighted in regard to this issue, could be students’ respect for their teachers, and other cultural inhibitions. In countries like Bhutan, students socially and culturally need to show respect to their elders like teachers (Rinchen, 2014). So, at times, even if they do not receive good support from the teachers, they may not say negative things about them.

The students who were interviewed generally perceived the teachers to be helpful and supportive in their mathematics classes. This is consistent with the survey results. Though teachers believed that they are helpful, in reality teachers believe that students are not motivated sufficiently to seek their assistance. This is compounded by the lack of resources, teachers’ teaching loads, large class size, provision of time for teachers to attend students’ consultation, and so on.

Though both the teachers and students indicated that there is good teacher support in Bhutanese mathematics classrooms, the classroom learning environment still requires improvement in terms of overcoming those obstacles as mentioned above. Teachers must look for the appropriate supportive strategies to encourage their students to come forward to seek support and consultation from them, such as creating a provision of time to approach them for consultation. Thus, teacher support is one of the key aspects of the teacher-student relationship, which is critical to any learning environment as this can determine whether the students are inspired to learn the subject or be turned away from learning (Afari et al., 2011; Velayutham, 2012). Further, it can be argued that these favourable perceptions of their classrooms might have been influenced by sociocultural factors. For instance, in Bhutanese context it can be culturally considered inappropriate on the part of students to say that their teachers do not support them.
5.3.2 Student Cohesiveness and Peer Support System

The scale of Student Cohesiveness assesses the extent to which students know, help and are supportive of one another (Dorman, 2008). It is one of the relationship characteristics of the classroom psychosocial environment, whereby each student is concerned about their mutual support of each other within their classrooms. The findings from the survey data showed that both the students and teachers perceived their classroom environments to be favourably cohesive. This was indicated by the respective mean scores for student perception (mean=4.17) and teacher perception (mean=4.24) for this scale.

Interviews with both the teachers and students support the findings from the survey in regard to perceptions of the scale of Student Cohesiveness. The results of the student interviews show that many of the students were positive about the support they gave each other, and the group work and pair work they did in their mathematics class. The comments made by different students indicated how they were able to seek mutual support from their friends and help each other. It is also indicative of the fact that they were satisfied with the way they worked and supported one another. They tried to relate to their experiences of cooperative learning in mathematics in classes, in which they had opportunities to seek support from one another. According to Palinscar (1998), “Social constructivist perspectives focus on the interdependence of social and individual processes in the co-construction of knowledge” (p.345). Hence, the students also indicated the application of social constructivist ideas in the form of cooperative and collaborative learning structures such as ‘Jigsaw Puzzle’ exercises, where learners can use the idea of home group and expert group to share their knowledge and skills. Some of their perceptions about cohesiveness are reflected in the comments:
When I ask my friends to help me, they help me to explain,...what I didn’t understand. (Student: Pem, SC02/G1)

We have a home group and expert group. When we go to expert group, we have to make ourselves expert and come to home group and explain to our ‘group’ members. (Student: SC02/G1)

Yes Sir, sometimes, our classmates they do not understand, they get support from us, and we explain to them. (Student: Nimchu, SC02/G1).

When we have doubts we share with our friends. And when they have problems, if we can, we try to solve them. If we cannot then we try to seek help from our teacher. (Student: SC06/G5)

In addition, the teachers were also of the opinion that their students were doing well in terms of collaboration and supporting each other in their schoolwork, as they encouraged them to work in groups and pairs in a variety of class activities. For instance, one of the teacher participants commented:

I think they are doing well in this regard. Because what I do is, I try to give the teacher input for a while, and then give some activities, and then later on, I encourage them to do works within their groups, and between their friends, like shoulder partners, and face partner and all (Teacher: SC06/T201).

Thus, the interview comments of students and teachers on the scale of Student Cohesiveness were consistent with the high mean scores from the quantitative data, which also supports the construct validity of the scale of the Teacher Support of the MCLES.

As most Bhutanese people generally live in joint-extended family and neighbourhood systems, the concepts of ‘peer support’ and ‘mutual coexistence’ are
deeply rooted in Bhutanese culture and traditions. Bhutanese are generally by nature willing, supportive, and helpful to one another, and if need be they even extend support and help to strangers. Thus, the peer support system among students may owe its origin to their family and neighbourhood systems. It must be noted that the new mathematics curriculum provides opportunities for students to further strengthen such cultural values and norms. For instance, almost all the learning activities under each unit and chapter in the new mathematics curriculum require the teachers to work collaboratively with children, which results in creating a conducive and child-friendly atmosphere within the classroom contexts. This enables teachers and students to develop a sense of unity and inclusiveness that generates happiness in both teachers and their students. This cultural influence has contributed to the peer support system in the classrooms.

Therefore, this aspect of the classroom learning environment requires the teachers to have acquired the required skills in classroom management, so that they can help their students to inculcate a sense of cohesion among themselves. This provides an opportunity for teachers in building a supportive classroom culture, and nurturing positive peer interactions and relationships among students. This in turn leads to social and academic integration as well as social support and academic success among their students. To this end, peer support plays a significant role in determining the learning environment of a classroom, where students spend most of their time every day.

5.3.3 Task Orientation and Nature of Tasks

The scale of Task Orientation assesses the extent to which it is important for students to complete activities planned and to stay on the subject matter (Dorman, 2008). This scale is important in the sense that the students need to have goals, both short-term
and long-term, which are clear and meaningful, and only then they are more likely to be engaged in their learning (Velayutham, 2012). Furthermore, in order to ensure students optimise their time-on-task, the teacher has to demonstrate clear expectations and provide frequent feedback and reinforcement (Aldridge, Fraser, Bell, & Dorman, 2012). For instance, students are ready to work extra time on their group project in mathematics so that the group can achieve their common goals.

The quantitative survey results indicated that most students and teachers felt that the students were well focussed and did not stray from materials that they were studying in their mathematics classrooms. The overall mean scores for students and teachers’ perceptions on the scale of Task Orientation were 4.28 and 4.12 respectively, indicating that students perceived their classrooms on the Task Orientation scale more positively than their teachers. However, there was a statistically significant difference in student perceptions of their learning environments in terms of school level for the scale of Task Orientation, where the mean score for lower secondary school students’ perceptions was higher (mean =4.33) than the mean score for middle secondary school students’ perceptions (mean=4.22) (see Table 4.9, p.155).

The interviews with the students and teachers indicated that students were generally concerned about their tasks; however, there were some exceptional cases where the students did not seem to be concerned about their tasks. The task orientation of students depends very much on the teachers’ pedagogical approach in relation to various characteristics of the given tasks such as the amount, nature, goals, and clarity of instruction about the tasks at hands.

The data revealed that the teachers were of the view that they should provide a lot of opportunities for their students to do tasks in groups so that they develop a
sense of belongingness and teamwork. It also indicated that teachers were aware that their students were concerned about their contribution to their group work and achievement of common goals for the group. Further, the data also showed that the teachers were satisfied with the outcomes of group work in their mathematics classrooms. This point is supported by the following comment made by one of the teacher participants:

So, giving group work and pair work, in these activities what they feel is that they feel they belong to these groups. So, they give their best, they also feel that “I need to contribute to and I cannot stay idle.” So, group work and pair work have been seen to be very productive (Teacher: SC02/T201)

Student interviews also indicated that they were really concerned about the tasks they did in their mathematics classes, and the importance of understanding the nature of the tasks. Hence, the clarity of the tasks at hand contributes to their positive perception of task orientation. It also showed that sometimes when the teachers give more tasks to do it becomes a matter of concern for them. This point is exemplified in the following comments made by some of the students:

Yes, if I don’t understand I go to teacher again and again, because I think doing my work sometimes is very important, for me to understand is necessary (Student: Lhazom, SC02/G1)

I am worried, because sometimes our teachers give us more questions to do, but if we try our best we can do anything. (Student: Tenchu, SC06/G2)

The group interviews with students also indicated that some of the students were also concerned with the amount of homework that was given in mathematics classes, and how they did their homework and how they got marked for it. In addition, some of them were also concerned about completing their tasks on time,
even if these tasks were difficult. These sentiments were expressed in the following comments from some of the student interviewees.

Sir, actually, teachers should not give us ‘too many home works’ on maths. So, sometimes, we become the ‘opportunist’ and we get marks for this question. (Student: Kencho, SC06/G5).

Yeah, I would like to complete my work on time. Even if it is difficult I will try my best. (Student: Sumi, SC13/G6)

Thus, though both the teachers and students believed that the students were generally task-oriented, which is consistent with the results of the surveys, the interview results indicated certain students’ reservations about their task orientation. It must be noted that teachers need to look for ways forward to organize and give a reasonable amount of tasks, be it class activities, homework or projects with clear instruction and focus, so that their students achieve expected goals.

5.3.4 Cooperation and Group Work

The cooperation scale measures the extent to which students cooperate rather than compete with one another on the learning tasks that are given to them in their mathematics class, and any other schoolwork (Dorman, 2008; Peer, 2011). According to Johnson, Johnson and Smith (2007), a collaborative learning environment provides the students an opportunity to work together to find solutions to given problems, while a cooperative learning environment would ensure students relate positively to each other and learn from each other.

The survey results once again indicated that both the teachers and students strongly believed that the students cooperate among themselves in the classrooms during any kind of activities and assignments in mathematics. The mean scores for
teachers’ perceptions and students’ perceptions of their classrooms were recorded as 4.26 and 4.13 respectively. Statistically significant gender difference was found for this scale in case of student samples, with boys scoring a mean of 4.07 and girls scoring a mean of 4.18. The findings from both the teacher and student interviews were consistent with the survey results, which indicate that the students displayed a high level of cooperation amongst themselves in the process of learning mathematics.

However, the sense of cooperation and team-work among students can be enhanced if they have more opportunities for collaborative group activities and pair works rather than independent activities within or outside their classrooms. The teachers believed that group activities help their students to cooperate among themselves. This point is exemplified by the following comments made by one of the teacher participants:

*I think they are doing well in this regard. Because, what I do is, I try to give the teacher input for a while, and then give some activities, and then later on, I encourage them to do works within their groups, and between their friends, like shoulder partners, and face partner and all. I have noticed them doing well, and the good amount of cooperation was displayed during those group activities.* (Teacher: SC02/T201).

The interchanging of their groups and group members when they are doing group activities also creates the opportunities for students to collaborate within their own groups as well as other group members. It was revealed that the students also realized the importance of group work, which creates the opportunity for them to learn from each other. This implies the positive impact of the new curriculum on their perceptions of classroom learning environment as being highly cooperative in nature. The following comments made by some of the student interviewees support this point:
We change the group every time, Sir. If we today, ..if we do a group work today, or we will make a new group today Sir. If we do again group work next time, we will change the groups or members, Sir. (Student: Tashi, SC06/G4)

In mathematics we do lots of groups work and pair works. I think it is very important because we get to learn more.... from our friends. And we can also share our opinions to them. (Student: Naina, SC02/G2)

The results from the student interviews were also indicative of the fact that they really had the opportunity to cooperate and support one another in their mathematics classrooms in terms of sharing materials, opinions and ideas, and solving mathematical problems. This point is supplemented by the following comments from some of the student interviewees:

Yes, Sir. We share our ideas with each other. Sir (teacher) always gives us group work and we have the opportunity to share our opinion to our friends. (Student: Tashi, SC06/G4)

Yes, Sir, we share our materials with our friends, Sir. Sometimes... we forget to bring them so we will borrow from our friends, and even we will, even I will share my materials. I am sharing my materials with my friends like pen pencils, erasers, and protractor, and compass and all, Sir. (Student: Dekar, SC06/G4)

Sir, my classmates, when they have problems in maths, they come to me, and ask me whether I can solve it or not. Sometimes I try to solve it, but when I can’t solve and then I ask our teacher, and the teacher solves it. (Student: Karma, SC06/G6)

Thus, it is the responsibility of the classroom teachers to further enhance the sense of cooperation among their students. They need to design appropriate activities to create a classroom learning environment where all students enjoy working hard.
and learning mathematics collaboratively rather than competing in their tasks. Hence, group work and pair work are seen as the major means to bring students together in classrooms and help them collaborate in achieving the common goals for their groups.

5.3.5 Equity and Teacher Professional Ethics

The Equity scale is one of the system change dimensions of the classroom psychosocial environment, and it assesses the extent to which students are treated equally by the classroom teacher (Aldridge, Fraser, & Huang, 1999). In other words, it gives an indication of how fairly the students are treated by the teachers in their mathematics classrooms. This element is important to ensure that the teacher provides equal and unbiased opportunities for all the students in the same class.

However, the concept of equity as a scale of the classroom learning environment can be considered not only from the perspectives of teachers, but also from students’ perspectives. In other words, we can assess the extent to which students are treated equally by their peers and classmates in their mathematics classrooms. In this respect, the interview data went beyond the scope of the survey questionnaire. The findings from the quantitative data revealed that most teachers perceived the scale positively (mean=4.63), meaning that they believed that they treated their students equally in their mathematics classrooms. The students’ perceptions (mean=4.29) were much lower as compared to the teachers’ perceptions (mean=4.63) of the scale of the Equity.

The interviews with teachers generally indicated that they were impartial and were treating their students equally. Students’ comments on this scale were absent, while some of the teachers were of the view that they were able to treat their students equally. The teacher interview data indicated that teachers believed that they could
treat their students equally in terms of any kind of learning activities such as reading, writing, speaking, problem solving, and so on. They also believed that they could provide equal opportunities to each one of them, and an equal provision of time while doing activities in the class. This is exemplified by the following comment made by one of the teacher participants:

In terms of that I think, I am trying my best. We have learnt something called the cooperative learning, that is, Keagan’s cooperative learning. So, they have different structures such as Round Robin, Rally Robin, Round Table, and Rally Table. There are so many other structures. So, while using these structures, the time is very important. Each child gets equal opportunity to …..say, if it is writing activity, they get equal time to write, and if it is oral activity like spoken activity they get equal chance to speak as well. So, through using such structures, I think, I am trying my best to give them the equal opportunity, Sir. (Teacher: SC02/T202)

The analysis of teacher interviews also revealed that some of the teachers believed that it is each individual students’ right to speak and act the way they like, despite whether their answers are correct or wrong, and the teacher should provide equal opportunities to them. This point is supported by the following comment made by one of the teacher participants:

I personally feel that it is every student’s right to speak out. Therefore, regardless their answers I give equal opportunity to all the students (Teacher: SC02/T201)

The student interview data were also indicative of the fact that the students in Bhutanese secondary schools treated their classmates equally, and their friends also reciprocated in a similar manner as well. This point is supplemented by the following comments made by one of the students as follows:
Further, the student interviews also indicated that the students believed that they were able to get equal opportunities to contribute to class discussions and presentations. This is exemplified by the following comment made by a student:

*Yes, I get the same opportunity to contribute to the class discussion.*
(Student: Geyden, SC02/G2)

The results of interview data indicate that both the teachers and students were of the view that the issue of classroom equity was well addressed in Bhutanese mathematics classrooms, whereas the quantitative data results showed inconsistency between the teachers’ and students’ perception of this scale. The teachers tended to be comparatively more satisfied than their students about the equity in their classrooms.

However, the issue of equity within the classroom may be resolved if and only if the teacher is professionally committed to supporting each of his or her students ethically and morally. The issue of equity in the mathematics classrooms arises in relation performance tasks, assessment of tasks, class tests, discussion in the class, and many other classroom activities. Equity as a classroom learning environment scale may be determined by the professional ethics and commitment of the classroom teachers. If the teachers are professionally and ethically committed towards their students’ learning, then they will treat all of their students equally in all aspects of the teaching-learning process. Thus, the scale of Equity is a matter of treatment of all students equally by the teacher, and the students treating their classmates equally in every respect, and all the parties concerned being open to negotiation and discussion as and when issues arise.
5.3.6 Critical Voice and Students’ Respect for the Teacher

The Critical Voice scale of the MCLES assesses the extent to which students are able to critique and evaluate the teachers’ pedagogical plans and methods constructively, and raise their concerns about impediments to their learning (Aldridge, Fraser, Taylor, & Chen, 2000). This involves both the students and teachers to critically observe and evaluate the teaching-learning process in their mathematics classrooms, and is subject to open discussion and negotiation between the teachers and students.

The quantitative data results (see table 4.9) indicated the lowest mean score (3.83) for students’ perception of the scale of Critical Voice among the eight MCLES scales, while the teachers’ perception of the scale had a much higher mean score (4.52). Interviews with both the teachers and students suggested that this dimension of the MCLES could be influenced by the degree of respect which students in Bhutanese school contexts generally have for their teachers. According to Rinchen (2014), Bhutanese students do not usually question or challenge their teachers, even if they are wrong, as talking back to the teacher is culturally inappropriate. In addition, Rinchen (2014, p. 23) in the following statement, elaborates on how Bhutanese students show respect to their teachers in their day to day classroom life:

Bhutanese students have high regard for their teachers. Students usually greet their teachers with a bow of their head and offer to help their teachers. Students customarily stand as teachers enter and exit the class. As a mark of respect students rise to talk whenever he/she is summoned by the teacher to speak. A teacher is considered as a source of knowledge and students as silent receivers of that knowledge.

It is not surprising that in such a context, classroom interactions normally become univocal, or one way communication dominates the lesson, meaning only the teacher goes on speaking in the classrooms, while students listen passively. Hence,
the teachers in Bhutan are highly respected by their students, parents, and the society at large. They are even more respected in rural and remote schools than in urban and semi-urban schools. It is generally known that the teachers in Bhutan hold professional status within the community and are respected as experts in their own field of learning. In contrast, some of the teachers were of the view that their position in Bhutan, especially among educated groups, and even at the official level, is considered as a service rather than a profession. They believed that a teaching position has a relatively low status compared to any other profession.

However, because of cultural norms such as courtesy and respect for elders and teachers, Bhutanese students generally do not criticize or question their teachers openly. Neither they can comment on the way teachers teach them, nor can they complain about the class activities and teaching methods, and so on. In other words, the questions on critical voice were avoided indirectly avoided by students. In spite of this, they wish to say good things about their teachers. The results of the student interview data suggest that the students had opportunities to engage themselves in group discussion and other class activities. Both boys and girls believed that they had the opportunity to clarify their doubts as and when required from both the teacher and their friends. This point is supplemented by the following comments made by the students during the interviews:

*Yes, we do, we do all these things. Whenever, we do not understand the question or the process, or the calculation, then we always ask our teachers, and also our friends. And that is, we also get full ‘support’ and cooperation to understand the questions. (Student: Purnima, SC02/G1)*

*We often get it because, Sir…Our math teacher is always with us and she helps us very much. If we have doubt also, if we ask, Sir, she will explain to us. (Student: Chizom, SC02/G2)*
“Every time, Sir. When we have doubts, without hesitating we ask doubts to our teacher and friends, Sir. (Student: Chenjur, SC06/G4).”

Thus, the constructivist classroom environment requires both the students and teachers to be critical of their teaching and learning in the classrooms. The teachers must create opportunities for their students to share and explain their ideas in smaller groups as well as to their classmates as a whole. The students need to be encouraged to ask questions to teacher and among themselves about what they are taught and how they are taught, and negotiate about their learning tasks and assessment criteria. However, at the same time, both the teachers and students, and students and students, must respect each other for the smooth functioning of the classrooms and the schools and, ultimately, for better student learning.

5.3.7 Personal Relevance and Student Attitudes

According to Aldridge, Fraser, Taylor & Chen (2000), the Personal Relevance scale is concerned with how the school mathematics connects to the learners’ out-of-school experiences and their everyday lives. In other words, it is concerned with the connectedness of a subject with students’ real world experiences. As per the results from the MCLES, Bhutanese secondary school students from rural places perceived mathematics to be personally more relevant than did their counterparts from urban areas. There seems to exist a significant relation between students’ attitudes and students’ perceptions of the extent to which teachers make the mathematics classes personally relevant to them. The survey results indicated a somewhat lower mean score for the students’ perception (mean=3.88, SD=0.73) than the teachers’ perception (mean=4.10, SD=0.52) of their classrooms.
The teacher interviews revealed that the teachers appreciated the new curriculum in terms of creating positive classroom environments through the use of appropriate methods and strategies according to their abilities. Hence, the new curriculum can offer better learning environments, but it is in the hands of teachers and students to take advantage of such possibilities. This point is supported by the following comments made by some teachers:

But there are some teachers who express this curriculum is quite rich. They say, this curriculum is quite good because it has simple language, because it has different activities. One of the aspects, I have seen in this new curriculum mathematics, in delivering any concept, it enumerates ‘a variety’ of strategies. Say, for example, to solve the problems in linear equations, there are varieties of strategies, methods, different methods.(Teacher: SC06/T204)

Further, the teacher interviews indicate that some of the teachers claimed that they tried to make the mathematics learning as relevant as possible for their learners. Even for teaching simple topics like addition and shapes they seemed to use practical activities such as taking their children outside the class and exploring natural shapes and so on. So, despite the difficult nature of the subject and the examination-driven curriculum, the students felt that their teachers go out of their way to make mathematics lessons relevant to their everyday lives. This is supported by the following comments made by one of the teachers.

In new curriculum, to get to addition, there are lots of activities to get to before that. Even teaching of patterns, these are new, which was not there in the old curriculum. When we teach patterns, we take children outside, it is not confined to four walls of classroom, and it goes beyond that. (Teacher: SC02/T202)
The student interviews also indicated that their attitudes towards mathematics classes could depend on their ability level, and how they concentrate in the class. Students with higher abilities appeared to have better attitudes towards their mathematics class than students with lower abilities in mathematics. In addition, the students generally agreed that mathematics is a difficult subject, and their outcomes would depend on their hard work. This is evident from the following comments made by some of the student interviewees.

Yes, Sir. I think it is important and useful too in my life. (Student: Lhawang, SC02/G2)

I don’t agree with this, because, if we try we can do anything. To me mathematics is interesting, and sometimes it is difficult, but in case of that we can ask our mathematics teachers, and then I can learn more. (Student: SC05/G5)

For me mathematics is quite hard, but if we try our best, it is not that hard. So it would be,...after all it is useful to us. (Student: Lhawang, SC02/G2)

The interviews suggested that students with high ability were more likely to enjoy given mathematical games and activities, leading to meaningful learning for them. In contrast, students with low ability were inclined to find mathematics lessons boring and unnecessary for their future. This is exemplified by the following comments made by one of the students:

Yes, because, every time listening to the lectures, I feel that sometimes, we students sometimes become very bored. There are many subjects where lectures are important. And so, if there is some kind of games, we feel interested in it and so, we will learn more. (Student: Yangzom, SC02/G1)

Thus, there are a wide range of factors, which affect the scale of personal relevance as the scale of the classroom environment, which signal that teachers and
administrators need to be cautious while going for new innovations. McRobbie and Tobin (1997) argued that, “Learning can be enhanced if students are able to link what they know to what they are to learn, if they feel what they learn will be of importance for the future as well as for the present, and if they are interested in what they are to learn” (p. 202).

With the infusion of GNH philosophy into the school curriculum in the recent past, Bhutanese society has already witnessed increasing calls for reform in the quality of education, including mathematics (Zangmo, 2014). This includes major elements such as making the mathematics curriculum meaningful for learners in terms of their everyday lives and interests, and developing of their understanding and their thinking skills in such a way that they can own the credit for their own knowledge. Thus, it all depends on their attitudes and beliefs towards the subject to see how they can make learning mathematics personally relevant and meaningful for their lives.

5.3.8 Student Negotiation and Competition in the System

According to Aldridge, Fraser, Taylor, and Chen (2000, p. 49), “The Student Negotiation scale assesses the extent to which opportunities are available for students to explain and justify to other students their newly developing ideas and to reflect on viability of their own and other students’ ideas.” The quantitative data results revealed that students in Bhutanese secondary schools perceived statistically less significant opportunities for negotiation in their mathematics classes. This is indicated by the lower mean scores for student perceptions (mean=3.94) as compared to teachers’ perceptions of classroom environment (mean=4.22).

Interviews with both the students and teachers generally did not reflect much on this result. However, some of the students were of the view that the group work
and pair work provided them with the opportunities to discuss and negotiate their problem-solving and share and learn from each other. Some of them were also of the opinion that since they are all different, they have different ideas to share with one another. This is exemplified in the following statements by some of the students.

Yes Sir, if in group work, if we present and we pass, we go in front of the class, we explain to the class, we explain to all the students. (Student: Chenjur, SC06/G4)

We have different students in a class, and they have their different ideas, Sir. All of us have different ideas, so that we can understand what other students are thinking, and we can also share our feelings with them. (Student: Lemo, SC06/G4)

Students also felt that they had a provision of time for listening to each other and learning from each other; however, there has to be a lot of opportunities for them to work on variety of class activities such as group discussions, group presentations, and group poster work and so on. Thus, the students then would have enough activities to work on in groups and pairs so that they can discuss, talk, negotiate and explain their own ideas and listen to one another, and learn from each other. This is supplemented by the following comments from some students.

Sometimes, they agree with us, but sometimes they have got their own views, Sir. Yes Sir, different point of views, Sir. (Student: Yangzom, SC02/G1)

Yes, my friends listen to me. Because in our class, we are sometimes, our class teacher creates activities like ‘round robin table,’ ‘round rally table’ and so on. In that case, all my friends listen to me and I too listen to their opinions. (Student: Gyeden, SC06/G2)

Anecdotal evidence suggests that the lack of competition in the education system, particularly, at lower secondary schools, could be a contributing factor in the
amount of student negotiation that takes place in mathematics classrooms. As compared to grade 10 and 12, grade 8 students do not have to face stiff competition in public examinations, and they can afford to relax in the process of teaching-learning in the classrooms. Hence, although in Bhutan, good examination results are still considered to be of paramount importance in terms of passing public examinations, at lower secondary schools students just have to meet the required cut off point to go to higher grades in government schools. Students and others normally associate a teachers’ move towards student-centred methods with the teachers’ lack of confidence in teaching that particular subject. Hence, teachers are literally forced to use more of a teacher-centred approach. This provides only a few opportunities for working on group activities that include student negotiation and that do not give a great deal of pressure for the students.

It appears that the lack of a sense of competition in Bhutanese lower secondary schools allows the teachers more time for class activities that include opportunities for student negotiation. However, many of the mathematics classes that were surveyed could not move away from the teacher-centred lessons that were so prominent in Bhutanese schools and could not include various group activities that provided the opportunities for students to be involved in negotiation at different levels. This was mainly due either to unavailability or a limited supply of material resources to classrooms.

5.4 Contextual Factors affecting Mathematics Classroom Environments

The interview analysis also involved the examination of some of the contextual factors that affect the classroom environment as well as the implementation of the new curriculum. These factors could be organizational, instructional, curriculum-related or sociocultural in nature, and can be either enabling or inhibiting to the
organization of the classroom environment, which ultimately influences the effective implementation of curriculum. Although there are numerous contextual factors that affect the learning environment and the implementation of curriculum; only the eight factors that are considered relevant and significant for the study are reported here.

Table 5.2 below shows the categorisation of these major contextual factors into organisational factors, instructional factors, and curriculum factors (Handal & Herrington, 2003), and each of the sub-sections that followed elaborate on these factors.

**Table 5.2**

Classification of Contextual Factors which Influence Classroom Environment

<table>
<thead>
<tr>
<th>Organizational Factors</th>
<th>Instructional Factors</th>
<th>Curriculum Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Resources and materials</td>
<td>▪ Professional development workshops and trainings</td>
<td>▪ Medium Instruction and Standard of English communication skills</td>
</tr>
<tr>
<td>▪ Leadership and administrative support</td>
<td>▪ Teacher attitudes and beliefs</td>
<td>▪ Use of technology in teaching mathematics</td>
</tr>
<tr>
<td>▪ Motivation, incentives and rewards</td>
<td>▪ Teachers’ classroom management and organization skills</td>
<td></td>
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</tbody>
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5.4.1 Lack of Resources and Classroom Materials

Bhutanese school contexts often lack classroom teaching-learning materials such as basic teaching aids, textbooks, manuals, charts, grids, graph papers, and technology. The basic teaching-learning materials must be made readily available in each and every classroom so that the teachers can make best use of them in organizing a variety of learning activities (Curriculum & Professional Support Division [CAPSD], 2005). The availability of resources and classroom materials always helps make the
learning experiences more interactive and meaningful. This leads to concrete experiences in learning mathematics that enhance abstract meanings and explanation, leading to improvement in the process of classroom interactions. In contrast to this, the lack of resources, particularly in the mathematics teaching and learning process, adversely affects the classroom interactions and effectiveness of class activities, resulting in poor student learning outcomes. It has been observed that many schools in Bhutan still face an acute shortage of teaching-learning resources (Rinchen, 2014). The findings from the interview data are consistent with this observation.

The teacher interviews revealed that the lack of resources and classroom materials act as one of the major constraints in Bhutanese mathematics classrooms, as materials are provided only in limited quantity. In the absence of these basic required materials, there is little opportunity for teachers to make their mathematics learning motivating, enjoyable, and authentic to their learners. The teachers were also of the view that the amount of material supplied to classes does not match the class size, and the teachers find it difficult to give the correct mathematical concepts such as different shapes. This point is supplemented by the comments made by some teachers:

*The other factors could be in most of our Bhutanese classroom is resource, that is, teaching learning materials. Because this new curriculum is different from one which we had earlier, this curriculum demands for lot of materials, teaching-learning materials. There are so many activities which are to be taught through games. So, in order to carry out these activities, when teachers do not have enough materials, it would be literally difficult. (SC02/Teacher 204)*

*Actually, these materials are being sent by the Ministry, but when we have a large number of children in our classrooms, it is not enough. For example, when we are teaching shapes such as pyramid, prism, and all, we need to
give shapes to individual children, then, let them feel and talk about the shapes. But we cannot really provide them individually, because it is not enough. (Teacher: SC02/T202)

The new curriculum was very demanding, and... it was asking me to give printouts and handouts, and all. But then due to the resources I had a really challenging time. (Teacher:SC02/201)

Thus, the lack of resources and materials can restrict the teachers’ use of those new teaching strategies proposed in the new mathematics curriculum, as well as inhibit group-focused learning activities in the process of teaching and learning mathematics. However, despite there is an issue in regard to resources, the 8th grade students’ and teachers’ perceptions of their mathematics classroom learning environment were positive. This is indicative of the fact that Bhutanese students and teachers are more concerned about the psychological aspects (eight constructs of MCLES) of the classroom rather than their physical aspects such as resources and classroom materials. This can also be explained as a cultural issue rather than a psychological one, because it is not guaranteed whether research participants expressed their authentic views or not.

5.4.2 Leadership and Administrative Support

Manouchehri and Goodman (1998) maintained that the quality of classroom teachers’ activities, either individually or collectively, depends heavily on guidance provided by the leadership at the school and district levels. For example, the leadership provided by a mathematics subject coordinator, principal or subject expert acts as the primary social influence on teachers in the field. It was argued that one of the fundamental elements of the process of change is the “leadership of change” (Maxell & Namgay, 2014, p. 32). Hence, the presence or absence of progressive
leadership and administrative support can contribute to making significant differences in the effective implementation of the new curriculum. The lack of such strong leadership and administrative support within the school system definitely inhibits the process of effective curriculum implementation.

However, the interviews with the teachers revealed that there was a mix of opinion in regard to leadership and administrative support provided by school managers and educational leaders in Bhutan. Some of the teachers were of the opinion that the school administration was supportive, and some of them even encouraged the teachers to come forward with anything creative that would help their students to learn better. On the other hand, some teachers felt that their school management was not fair and equitable in terms of nominating appropriate people for workshops and trainings, so that they could contribute to the schools accordingly. This is exemplified by the comments made by some of the teacher interviewees:

*Compared to the remote schools, the present school administrators as well as from management side, they are giving their best. Till now I did not face any problems with regard to printing and all. They are always welcoming us to come forward with anything that could help the students learn better. (Teacher: SC02/T201)*

*Yeah, support is there, from the administration side. And from this year our principal, she was encouraging us to use ICT in our teaching. And recently, we have also introduced ICT room in the school. (Teacher: SC06/T205)*

*Sometimes, the school management nominates a wrong person and is sent to the orientation programs. And once they come back they do not teach the same subject, in which they were oriented. And the person who has not attended the orientation programs has to take up the subject. And then there is another problem there, Sir. (Teacher: SC02/T202)
Thus, when there is a lack of good leadership and administrative support at the schools there are implications for classroom teaching and the learning process in schools. This is because when leaders and administrators fail to recognize the felt needs of the schools and the benefits of positive learning environment, they do not receive the required support from them. As a result, the classroom teachers cannot execute the curriculum implementation properly, and students as learners and the system as a whole do not benefit.

5.4.3 Professional Development Workshops and Training
Professional development for teachers plays a significant role in the teaching and learning of mathematics. The practice of professional development workshops and seminars is very important for classroom teachers’ growth and enhancement of their knowledge and skills. They have to continue learning in order to encourage and support their students to work hard and learn. It has been argued that professional development can change a teacher’s attitudes and beliefs towards the new curriculum as well as provide them with the knowledge and skills to implement the new curriculum (Hew & Brush, 2007). In addition, professional development workshops and trainings also help teachers learn new teaching strategies and cope with the curriculum change.

The interview data indicated that there is a lack of professional development training and workshops in Bhutanese school systems, which is one of the major enabling factors for effective teaching and learning of mathematics associated with the new curriculum. There seems to be a lack of proper systems or mechanisms for organizing professional development workshops and training for teachers. It was indicated that though the Ministry of Education has been trying to organize professional development training, workshops, and seminars for teachers, it needs
further reinforcement in terms of its practices and distribution among mathematics teachers. In addition, such training and workshops should have a ripple effect on school systems and ultimately benefit students. This fact is shown in the following comment made by one of the teacher interviewees:

With regard to the orientation of new curriculum, I feel that there are still teachers in the field who are not oriented with this curriculum. From each school a subject teacher, one teacher is oriented. And actually, the expectations of Ministry of Education and the Dept. of Curriculum, is that each school should nominate a teacher from one school to attain the workshops, orientation workshops, and back in the schools they are supposed to do that. SBIP to be conducted and the same orientation they received in the orientation workshops to be done in the schools. But in most of our schools this is not happening. When this is not happening, the other subject teachers are teaching without the orientation skills of the new curriculum. Therefore, they are teaching based on the concepts and skills that they have to deliver for the old curriculum. For this we need good skills. (Teacher: SC06/T204)

There is still a need to organize familiarization workshops on the new mathematics curriculum so that all teachers can teach without problems. Some of the teacher participants were really concerned about the problems faced by their teacher colleagues, who did not have familiarization workshops or orientation programs pertaining to the new curriculum. It was revealed that those who had orientation or training workshops had no problem in handling the new curriculum, but those who did not receive professional training and orientation faced difficulty in teaching the new curriculum. This is supported by the following comments made by the teachers:

I think, to orient teachers in this new curriculum is very important. Because, some of our friends here, they did not receive any orientation programs on this new curriculum, and they are facing problems. ....But, as far as I am concerned, I have received the orientation programs. So, I don’t have
problems. But, my teacher colleagues who are not oriented, they have problems. And sometimes, they come and share with me, and then I try to help them. So, training, I think, to give training to teachers is very important, when the curriculum is being changed. (Teacher: SC02/T202)

It was also revealed that there is no proper distribution of professional development training and workshops or there were too few training and workshop sessions offered to the field teachers. Since they never received training, some of the field teachers resorted to orienting themselves by using the textbooks and manuals. This fact is revealed by the following comment made by one of the participants.

*I have been in the teaching for 13 years, and I have never attended any workshop or seminars or retraining. And again, since starting with this new curriculum, so we are just using manuals, and we are just going through textbooks, and just teaching. So, we never got any training or seminars!* (Teacher: SC02/T203).

Some of the teachers were also of the opinion that subject related school-based in-service programmes (SBIPs), workshops or seminars at the school level were also scanty. So, it seems that teachers could be updated with new teaching strategies and processes of teaching and learning of new mathematics. This is exemplified in the following comments made by some of the teacher interviews:

*But, then, it is tragic to say that SBIPs are seldom done for curriculum or subject-wise. Because, most of the things are for like Disaster or other things like Global Hand Washing Day, Health or Games and all, Sir. Subject-wise SBIPs are quite rare and even workshops, and others are done seldom, la.* (Teacher: SC02/T201).

Thus, the Department of Curriculum and Research Development (DCRD) need to organize and enhance the system of professional development training and
workshops for teachers in the form of national based in-service programmes (NBIPs), or school based in-service programmes (SBIPs), which can benefit school systems as a whole and ultimately the learners.

5.4.4 Teachers’ Beliefs and Attitudes towards New Curriculum

Teacher attitudes and beliefs can also influence the implementation of the new mathematics curriculum. Attitudes can be defined as “specific feelings that indicate whether a person likes or dislikes something or someone” (Simpson, Koballa, Oliver, & Crawley, 1994, cited in Hew & Brush, 2007, p.229). According to Jamtsho (2001), people’s attitudes are predispositions in the way they react to an object or experience. More importantly attitude is a hypothetical construct, which one can infer from what people say and do. In the context of this study, teacher attitudes toward the mathematics curriculum can be conceptualized as teachers liking or disliking the new mathematics curriculum in the process of its implementation in Bhutanese schools.

Hew and Brush (2007) defined beliefs as those premises or suppositions about something that are felt to be true. Teachers’ beliefs typically may include their educational beliefs about teaching and learning (pedagogical beliefs) and their beliefs about the new mathematics curriculum. Research found that though teachers’ actions are not always consistent with their stated teaching beliefs, teachers’ beliefs play important roles in the teaching and learning process (Wahyudi, 2004). The teacher interviews indicated the change of their attitudes towards the subject, which is evident from the following comment made by one of the teacher interviewees.

*I think teaching this new curriculum is interesting, and both teachers and students they really enjoy teaching and learning of mathematics. Actually, I used to hate teaching mathematics, but with this new curriculum, I am enjoying a lot. In fact, I prefer teaching mathematics to other subjects.*

(Teacher: SC02/T202)
Hence, if the teachers have positive attitudes and beliefs towards such a new innovation such as the new curriculum, it would definitely be a success and vice-versa (Handal & Herrington, 2003). In order to have an exciting and positive classroom learning environment, the teachers must adopt new teaching strategies and change their mind-sets for good.

In addition, the match between curriculum goals and teachers’ belief systems can lead to positive perceptions of the classroom environment, while a mismatch between these two variables would act as an inhibiting factor to the classroom atmosphere. According to Wahyudi (2004), curriculum intent comprises aims, goals, and objectives given in curriculum documents, which are meant to be achieved by learners as they interact with the curriculum. Some of the teachers were of the opinion that the new curriculum demands a lot of teacher efforts, time and resources in terms of its effective delivery, and they believed it to be a student-friendly curriculum, not teacher friendly. This point is exemplified in the following comment by one of the teacher interviewees.

"From my point of view, it is a student-friendly curriculum. Not a very, very teacher-friendly, because teacher has to work almost more than the students, although, it has been made easy as compared to the old curriculum, but the teacher has to work more than the students. (Teacher: SC06/T205)"

Teachers’ beliefs about the new mathematics curriculum can have a direct impact on the implementation of this curriculum. Thus, there is a need to account for the teachers’ beliefs regarding the curriculum with new instructional reform practices or policies in order to make mandated reform structures and new curricular approaches successful under the new curriculum framework.
5.4.5 Teachers’ Classroom Management and Organization Skills

Teachers’ lack of classroom management and organization skills also influences the quality of the teaching-learning process (Chandra & Mills, 2014). It seems that some of the mathematics teachers in the Bhutanese system lack skills in organizing and managing lessons and learning activities aligned with the framework of the new curriculum as they had little orientation to the process of teaching new mathematics. In other words, their classroom organization skills are inconsistent with the framework of teaching and learning in the new curriculum. Some of the teacher interviewees were concerned about their classroom organization skills in terms of the delivery of the new curriculum mathematics in Bhutanese schools. One of the teacher interviewees commented:

Children are very much interested in such activities. They look for such activities; they express their positivism, when they are organised into groups. But what is important in carrying out group activities is proper management and instructions have to be given. Otherwise, there are children who get misguided and do not achieve what they are supposed to achieve. (Teacher: SC06/T204)

Stronge, Ward and Grant (2011) argued that classroom management should be based on respect, fairness, and trust, wherein a positive climate is cultivated and maintained. They further pointed out that a productive and positive classroom is the result of the teacher’s consideration of students’ academic as well as social and personal needs.

5.4.6 Medium of Instruction and Standard of English Language

Ever since the introduction of modern education in a secular form into Bhutan, English and Dzongkha (the national language of Bhutan) have been used as the language of instruction in Bhutanese schools. Dzongkha is used only to teach the
national language of Bhutan to all students across the school levels, while all the other subjects including mathematics, science, and history are taught in English right from pre-primary to grade 12, through to the university level. However, Dzongkha is the second language and English may be the third language for most Bhutanese students, and school subjects are taught in these two languages.

The medium of instruction used for delivery of lessons in mathematics or any other subjects definitely determines the effectiveness of the teaching and learning process in the classrooms. This in turn has led to challenges in creating positive learning environments in classrooms and many times classroom teachers have to resort to using a local language or national language to explain certain concepts and ideas. This is evident from the teacher interview data as indicated by the following comments made by some teachers.

One could be their level of English. Since the medium of instruction is in English, and when students are not good, not so good in English it is challenging for us to teach. Therefore, what I do is I resort to bilingual language; whenever possible I try to explain, and further explain in Dzongkha so that they could learn more. (Teacher: SC02/T201).

I try my best to encourage children to speak in English at all times. But, sometimes when they really need to discuss with their friends, and when they really need to explain the concepts to their friends, sometimes they do it in Dzongkha. But not all the times but, sometimes, when the concepts are really not understandable by other friends, sometimes, they need to use Dzongkha as well to give the correct concepts of the topic. (Teacher: SC02/T202)

Some teachers were also of the view that because of the low standard of English language among Bhutanese students, their students were not able to do well in mathematics. This is because the new curriculum in mathematics demands a good
command of language in terms of communication as one of its process standards. The new curriculum requires them to not only understand mathematical concepts and skills for themselves, but they also to express and share their ideas with the class as a whole or with their friends and teachers. Due to this problem, many students are reluctant to come forward and do class presentations, discussions, and explanation of their ideas to the class. This point is substantiated by the following comments made some teachers:

>This mathematics actually is a new and very easy mathematics. Any child, who has the ability of that level can easily perceive. But in our context, may be because the children have the low ability of language skills, because, this curriculum demands more of language ability. If a person has language ability, then through personal readings, the child can easily understand. But, because of this barrier, language barrier, teacher’s involvement is also necessarily felt. (Teacher: SC06/T204)

The medium of instruction and standard of English communication skills play a significant role in their understanding of mathematical concepts and word problems in the process of learning mathematics. Thus, though it may be claimed that mathematics as a discipline has its own distinct language and vocabulary, the English language in general has a significant bearing on student learning of mathematics. As mentioned earlier, since Bhutanese students are taught mathematics in English, it requires them to have a minimum proficiency in it for them to be able to communicate mathematical ideas and concepts to others.

5.4.7 Use of Technology in Teaching Mathematics
The literature regarding the use of technology suggests the inclusion of technology to enhance the practice of effective mathematics teaching. It has been found that students made greater achievement gain when they had access to technology that is
used to teach higher order thinking skills, and it also helps in the encouragement of critical thinking in students (Stronge et al., 2011). The use of technology has been one of the core five principles of NCTMs in the process of implementing a standards-based mathematics curriculum in the USA. Hence, the present curriculum reform in mathematics education in Bhutanese schools also recognizes the importance of the use of technology in teaching mathematics, in an era of “technologically-driven mathematics curricula” (Barkatsas, Kasimatis, & Gialamas, 2009). This is because the use of technology positively impacts on the core business of teaching and learning by changing teachers’ pedagogical approaches and the types of learning activities they designed and implemented (Chandra & Mills, 2014).

There is strong evidence to suggest that technology can enhance mathematical learning. According to Chandra and Briskey (2012), the use of ICT provides new options and opportunities for learning mathematics, which could be facilitated by the teachers’ willingness to review their pedagogies. For instance, web applications on the internet have been found to create new opportunities for learners who are actively participating to develop their abilities in mathematics (Chandra & Briskey, 2012). The following comment made by one of the teachers also supports the above NCTM principle and the significance of the use of technology in mathematics education.

*Other thing is, that, I don’t know may be IT technology, was not available in earlier curriculum time. But with this curriculum, if all schools in the country are equipped with IT facilities, I think the delivery of the new curriculum would not be, and will not be problem. Because, in our school here, also we have IT facility, using IT facility, we can download information from YouTube, and make children to learn and help them to learn on the particular topic. So, this curriculum demands a lot of IT expertise of a subject teacher. Again, if a subject teacher does not have IT expertise, then*
However, since the technology has come to Bhutan in very recent years, the integration of technology into teaching mathematics is good, yet there may be challenges ahead such as the lack of “specific technology knowledge and skills, technology-supported-pedagogical knowledge and skills, and technology-related classroom management knowledge and skills” (Hew & Brush, 2007, p. 227). In addition, the integration of technology into mathematics classroom has been always constrained by the difficulty of changing the mind set of classroom teachers, as well as the lack of resources, including technology itself (computers, software, peripherals, etc.), accessibility to available technology, and technical support.

5.4.8 Lack of Motivation, Incentives, and Rewards
The lack of motivation, incentives, and rewards also influences the classroom learning environment in Bhutanese schools. Both classroom teachers and students must be motivated, and rewarded at least verbally, socially and emotionally. This has always contributed to making the classroom environment enjoyable and successful in terms of student learning. Even providing varied opportunities for teachers to attain training workshops, seminars, and exchange programs (both in-country and ex-country) can act as rewards and incentives for teachers and motivate them further.

The teacher interview data were indicative of the fact that teachers were not given equal opportunities in terms of training, workshops or other professional development programs that would help teachers to upgrade their pedagogical skills and knowledge. They also felt the need to exchange their professional skills and knowledge with mathematics teachers and professionals from other countries. This is evident in the following comment made by one of the teachers.
According to Landon (2011), motivation pertaining to students has been consistently associated with academic competence, and can be exhibited in a student’s effort, persistence, and choice of activities. However, the issue of motivation, incentives and rewards can be considered at two levels: first, how the teachers are motivated and encouraged to teach their students; and second, how teachers are able to motivate and encourage their students to learn mathematics. In addition, it is important to consider what kind of incentives and rewards are being received by the teachers and students in the process of teaching and learning mathematics. Rewards in the form of physical things really do not matter, but even verbal praises and a sense of appreciation from the school administration can help in motivating teachers and students.

As mentioned above, the issues of equality and fairness arise when it comes to motivation, incentives and rewards, which always provides a challenge to the school management and administration, particularly pertaining to the opportunities for teacher training and workshops.

5.5 Chapter Summary

The chapter detailed a discussion on the validation of the findings from the quantitative data based on each of the eight MCLES constructs, along with their corresponding key factors. It also presented the results of interview data on the
emerging contextual factors, which can be classified into four categories: organizational, instructional, and curriculum-related, sociocultural in nature.

The qualitative results mainly consisted of descriptive commentaries for each scale of the MCLES, supported as far as possible by relevant interview quotes (verbatim of both teacher and student participants). Furthermore, the results on the emerging contextual factors were also presented with descriptive commentaries and interview quotes for each of them. As much as possible, both student and teacher perspectives were presented within the descriptive commentaries in order to compare and contrast their views on each of the MCLES scales. Although in general their perspectives were similar and supported the quantitative results, there were few cases that have not been able to substantiate the interview data.

Thus, the results of the qualitative data provide an understanding of the numerous contextual issues and factors that affect the context of the teaching-learning process in Bhutanese secondary schools. The whole context of national policy-making, explicitly or implicitly contribute to the factors affecting the classroom environment. Since the complex nature of those factors tends to affect both the process of curriculum implementation, and the classroom environment, cautious steps may be required when addressing large scale reform and restructure.
Chapter 6: Discussion and Conclusions

6.1 An Overview

A new mathematics curriculum was introduced in Bhutan in 2008 at the lower and middle secondary schools, which comprise grade 8 classes. Understanding the perceptions of students and teachers towards this curriculum is important because it can impact on students’ learning outcomes in mathematics (Fraser, 1998, 2001; Linda & Fraser, 2010). Thus, the main focus of the thesis was to investigate 8th grade students’ and teachers’ perceptions towards their mathematics classroom learning environments. It also examined those contextual factors that have influenced the learning environment in Bhutanese eighth grade mathematics classrooms, which in turn influenced the implementation of the new curriculum. The chapter is divided into these sections:

- Discussions of the main findings (Section 6.2)
- Implications of research findings (Section 6.3)
- Contributions of the Study (Section 6.4)
- Reflection (delimitation) (Section 6.5)
- Conclusion (Section 6.6)

6.2 Discussion of the Main Findings

This section presents a discussion of the major findings of this study. The current study provides an insight into how educators and teachers can understand the perceptions of both students and teachers towards the new mathematics curriculum in Bhutan. Such understanding can make a positive contribution towards the Gross National Happiness (GNH) aspirations because positive perceptions and happiness go hand in hand with each other. As reported in Chapters 4 and 5, the research
questions were answered by analyzing and using either or both quantitative and qualitative data. Hence, the salient results of the study are discussed in relation to the three research questions and their implications.

Thus, the first line of survey data analysis looked at the issues related to the reliability and validity of the adapted student version and teacher version of the MCLES as research instruments respectively. The second line of analysis focused on students’ and teachers’ general perceptions of the nature of the classroom learning environment. The analysis also investigated and compared their perceptions of the classroom learning environment in terms of gender, school level and school location. In addition, the qualitative data analysis was conducted to validate and complement the findings of the quantitative data, pertaining to the first two research questions, followed by the examination of contextual factors. Accordingly, the discussion and interpretation of the findings of the study were set in line with this process of analyses of data.

6.2.1 Students’ Perceptions of Classroom Learning Environment

The first research question of the study gave an insight into the students’ perceptions of their mathematics classroom learning environment.

Research Question # 1

*What are the perceptions of 8th grade students about their mathematics classroom learning environment in relation to the implemented new mathematics curriculum?*

The student MCLES questionnaire was administered to the sample (N=608) and interviews were conducted with a smaller group of participants to answer this question. Initially Cronbach’s alpha coefficients were determined using the individual student as the unit of analysis, that is to emphasize the concept of ‘Beta
Press’ (individual student perspective of their classroom environment) only. The alpha coefficients (α) ranged from 0.60 to 0.77. According to Nunnally (1994) as cited in Fisher & Chandra (2009), all alpha values were greater than or equal to 0.60 (i.e., α≥0.60), which suggested that the MCLES scales were reliable for this student sample in Bhutan.

The constructs of the student MCLES were validated subjecting the student survey data to discriminant validity analysis. The mean correlation coefficient of one scale with the other scales ranged from 0.39 to 0.45, when using individual students as the unit of analysis. Brown (2006) suggested the mean correlation coefficient of r≤0.80 as the required criterion for meeting the discriminant validity. Hence, the results reported suggest that the learning environment scales based on the MCLES were valid when used with this sample of grade 8 students in Bhutan. The findings for the reliability and validity of the MCLES as an abridged version of the WIHIC and CLES are comparable to those of previous studies that showed satisfactory internal consistency with samples from elementary school students to university students (e.g., Aldridge, Fraser & Ntuli, 2009; Allen & Fraser, 2007). In addition, internal structure of the instrument was validated subjecting the data to factor analysis which led to removal of 5 items in the student questionnaire.

The first finding in regard to the first research question was that the high mean scores, ranging between 3.83 (Critical Voice) and 4.29 (Equity scale) were recorded for all the scales. This indicates that in terms of the MCLES scales, the sample perceived their classroom favourably. The standard deviation for all the eight scales was quite small, indicating that there was no diversity in students’ perceptions. The results also indicated that the students generally perceived the scales of Teacher Support, Critical Voice, Personal Relevance, and Student Negotiation less favourably.
than the scales of Student Cohesiveness, Task Orientation, Cooperation, and Equity. These differences in their perception of classrooms may be attributed to several factors, such as teachers’ pedagogical orientations, cultural contexts, students’ personal characteristics, general school ethos and culture (Jamtsho, 2001; Yan & Kember, 2003).

Bhutanese classrooms are generally characterized by large class size, where on an average each section has 30-40 students, so that the teachers find it difficult to provide support individually. It is usually not appropriate for students to question teachers’ plan of instruction, activities and their pedagogical methods in their classes. It depends upon how the teachers are able to make the mathematical concepts and skills they learn in the class meaningful and personally relevant to their students and to their everyday life. It is also important how the teachers can create the opportunity for their students to have group interactions to allow for discussion, argument and negotiation, so that they learn from one another.

The results of item-wise descriptive statistics indicated the Item01-‘My teacher takes personal interests in me in this class’ (mean=3.10) from the Teacher Support scale, and Item26-‘It’s O.K for me to ask the teacher, Why do I have to learn this?’ (mean=3.30) from the Critical Voice scale recorded the lowest means amongst all the 40 items. However, the qualitative data seemed to contradict these results. The students’ responses indicated more favourable perceptions about teacher support and critical voice than the teachers’ responses. In fact, the teachers indicated that they were not able to support their students as much as they would have liked to. This was due to a number of constraints in the schools. These constraints included organizational (e.g., lack of resources, lack of proper training for teachers), instructional (eg., traditional teaching methods), curriculum-related (e.g., insufficient
textbooks and manuals), and sociocultural (e.g., students’ enthusiasm for learning, student respect for their teacher) factors which were discussed in Chapter 5.

Comparison of student perceptions based on gender showed some differences. Girls generally perceived their classrooms more positively than boys across the MCLES scales. Some research in other countries also indicated boys and girls held different perceptions of the same classroom learning environment (Bellar & Gafni, 2000; Majeed et al., 2002; Seopa et al., 2003). However, no significant differences were found between boys’ and girls’ perceptions of their classrooms in Arab elementary schools (Khalil & Saar, 2009). This can be attributed to certain sociocultural factors such as difference in boys’ and girls’ respect for their teachers, and the conservative nature of Bhutanese girls. However, while there were differences between the means, independent samples t-test results showed that these differences were only significant for the Cooperation scale (p˂0.05). The effect size of the differences in the means for each MCLES scale was consistent with the t-test results. For the Cooperation scale, effect size was moderate, which can be explained by the fact that Bhutanese girls are generally more cooperative than boys and seek support from each other. Boys, on the other hand tend to be more independent, autonomous and competitive than girls, and they do not usually cooperate with each other.

In terms of a comparison of student perceptions of their classrooms based on school level, descriptive statistics showed that students from lower secondary schools perceived their classrooms more favourably than students from middle secondary schools. The independent samples t-test results revealed that the differences in the means were statistically significant at the p˂0.05 level for the scales of Teacher Support, Student Cohesiveness, Task Orientation, Cooperation and Equity. Opolot-
Okurut (2010) reported statistically significant differences in students’ perceptions on some of the WIHIC scales between school types in relation to student motivation towards mathematics in the context of Ugandan secondary schools. Students’ perceptions of actual and preferred school-level environments in South Africa (Aldridge et al., 2006), and classroom climate in high school biology classrooms in Kenya (Mucherah, 2008), were investigated and statistically significant differences were observed. In the Bhutanese context, grade eight students are the graduating class and they are the pride and image of their lower secondary schools (LSSs). The school administration does their best to provide the students with more resources, support and the best teachers for them. On the other hand, grade eight students in middle secondary schools (MSSs) are in the lowest level, and possibly they do not receive much support and attention from their schools. Good teachers and resources are prioritized for senior classes in their schools. In addition, the other possible reason could be that grade 8 students in lower secondary schools have the responsibility to be role models among juniors, whereas grade eight students in middle secondary schools, they have to look for their seniors as role models. This probably explains the differences in the means at the school level.

In terms of school location, the findings from descriptive statistics indicated that students from rural schools generally perceived their classroom learning environment more favourably than students from semi-urban and urban schools. They perceived their classrooms to be comparatively less supportive, critical, relevant and negotiable in nature, and they considered it to be more cohesive, task-oriented, cooperative and equitable. Past studies (e.g., Huang, 2003; Shadrek, 2012) reported statistically significant differences in students’ perceptions of their classroom learning environments based on school location. The results of one-way
analysis of variance for repeated measures showed that the F-ratio was statistically significant on the scales of Teacher Support, Student Cohesiveness and Critical Voice, indicating significant differences in their perceptions on these three scales in all three different localities of schools. The differences in students’ perceptions of classrooms in the context of Bhutanese schools can be explained by the fact that most rural schools have boarding facilities, and the teachers and students have the opportunity to develop closer ties. They see a lot more of each other than their counterparts in urban schools. In addition, most of the urban schools are characterized by large class size, consisting of approximately 30-40 students in each class, while in rural schools the class sizes are small. Moreover, the value of education is very much emphasized in rural places than in urban areas, because rural people see classroom learning with a lot of hopes and aspirations for their children. This difference can also explain the variations in the means across the three scales of Teacher Support, Student Cohesiveness and Critical Voice.

The findings from qualitative data revealed that student interviewees generally believed their teachers to be supportive; in fact, the students held comparatively more positive perceptions about the Teacher Support scale than their teachers. The students’ comments on the scale of Student Cohesiveness were also consistent with the high mean scores from the quantitative data, which also supports the construct validity of the scale of the Student Cohesiveness of the MCLES. However, no comments were made on the scale of Critical Voice. Some of the possible reasons for this could be students’ respect for their teachers, and other cultural inhibitions, which restrict them from evaluating or questioning their teachers’ ways of doing things in the classrooms.
6.2.2 Teachers’ Perceptions of Classroom Learning Environment

The second research question was on teachers’ perceptions of their mathematics classroom learning environment in Bhutanese 8th grade classes:

Research Question # 2

What are the Bhutanese 8th grade teachers’ perceptions of their classroom learning environment in relation to the implemented new mathematics curriculum?

The reliability of the teacher version of MCLES was confirmed by calculating Cronbach’s alpha coefficients which ranged from $\alpha = 0.60$ (Equity scale) to $\alpha=0.86$ (Critical Voice scale). These indices for the scales of MCLES were consistently above 0.60 ($r \geq 0.60$) (Nunnally, 1994, cited in Chandra & Fisher, 2009), suggesting that the teacher version of the MCLES was a reliable tool for this sample of teachers in Bhutan.

The construct validity of the instrument was determined subjecting the teacher survey data to discriminant analysis of each scale of the MCLES. The mean correlation coefficient of one scale with the other scales ranged from 0.14 (Critical Voice) to 0.32 (Student Cohesiveness and Student Negotiation) using individual teachers as the unit of analysis. These results suggested that the scales of the MCLES measured distinct, yet some overlapping aspects of the learning environment (Koul, 2003). Furthermore, the internal structure of the teacher version of the MCLES ensured subjecting the data to factor analysis, which resulted in omission of three items in the questionnaire.

The first finding pertaining to the second research question was the very high mean scores for all the MCLES scales, indicating highly positive teacher perceptions towards their classroom learning environment. The standard deviation for all the
eight scales was less than 0.65 (Critical Voice) indicating that there was no marked difference in individual teachers’ perception of their classrooms.

Secondly, descriptive statistics indicated that female teachers generally perceived their classrooms to be less equitable and critical than their male counterparts. The possible explanation for this could be that in Bhutanese school contexts, mathematics teachers are mostly male at secondary schools and higher levels, and they may perceive gender inferiority complex. The results of one-way analysis of variance (ANOVA) indicated statistically significant gender differences in their perceptions of the Teacher Support and Critical Voice scales. The effect sizes were consistent with ANOVA results, which showed the smaller gender differences, indicating generally modest educational significance. Although not many studies reported gender differences in teacher perceptions of classroom learning environment, Huang and Fraser (2009) examined science teachers’ perceptions of their school environment and found statistically significant gender differences.

The findings from descriptive statistics indicated that lower secondary school teachers perceived their classrooms more favourably than teachers in middle secondary schools. The F-ratios from one-way ANOVAs indicated that school level differences were statistically significant at the level of p <0.05 for two out of eight MCLES scales (namely, Cooperation and Critical Voice). The effect size results also supported the above findings, indicating the school level influence on their perceptions is of less educational importance. Aldridge, Laugksch and Fraser (2006) also noted statistically significant differences in teachers’ perceptions of school-level environment in relation to outcomes-based education in South Africa.

Lastly, the teachers’ perceptions of their mathematics classroom environments were analyzed based on the school location (urban, semi-urban, and
Descriptive statistics indicated that rural school teachers comparatively perceived their classrooms more favourably than teachers in urban areas across the scales. One-way ANOVA for repeated measures was used to analyse the differences in the means across the scales. The F-ratios showed that in terms of the school location, the differences in the mean of Equity scale (p<0.05) was statistically significant. It might have been easy for rural school teachers to treat their students equally due to small class size, which might not have been possible in urban schools due to large class size. Besides, since most rural schools are boarding schools the teachers can have closer contact with their students than those from urban schools. Thus, it can be concluded that Bhutanese mathematics classrooms are not supportive, critical, relevant, and negotiable, rather than they are cohesive, task-oriented, cooperative, and equitable in nature.

The findings from qualitative data were also generally consistent with the results of the quantitative data. Most of the interview comments made by teachers supported the higher means shown by the statistical analyses. However, the teachers were not positive about the ‘Teacher Support’ scale in the sense that they were not able to provide support to their students as they expected due to resource constraints and other factors. Furthermore, there was no evidence of comments made by teachers in regards to some scales of the MCLES, particularly for the scales of Critical Voice and Student Negotiation. This might have been attributed to their understanding of the questions asked or the coverage of questions on these scales, which may be taken as one of the limitations of the interview schedule.

In summary, the study investigated students’ and teachers’ perceptions of classroom learning environment in terms of gender, school level, and school location, and validated the research instrument (MCLES) in Bhutanese classroom
contexts. Firstly, teachers tended to perceive their mathematics classrooms more favourably than their students. This could be possibly because teachers generally tend to believe that they do right things in the classrooms and do not normally want to underestimate their accountability towards their students’ learning. The finding was consistent with the previous studies (Fraser, 1998a, 2002; Huang, 2003; Murugan, 2013) in which the teachers also viewed their classroom learning environment more favourably than did their students. Secondly, female teachers and students were more positive about their classroom environment than their male counter-parts, which may partially be attributed to sociocultural factors such as in any society girls and women are seen to be more respectful and humble in nature, which to a large extent guides their thinking and mentality about their social life. Thirdly, lower secondary school (LSS) students and teachers generally held better perceptions than those of middle secondary school (MSS) students and teachers. Finally, rural school students and teachers held more positive perceptions about their classrooms than those from urban school students and teachers, which might be attributed to the numerous factors as explained earlier.

6.2.3 Factors Affecting the Classroom Learning Environment

The third research question, which this study intended to answer, was pertaining to the contextual factors that uniquely affect the perceptions of mathematics classroom learning environment in Bhutanese schools. This question was answered by qualitative interview data employed particularly with the teachers.

Research Question # 3

What are the unique contextual factors that influence the mathematics classroom learning environment in Bhutanese schools?
This study examined the contextual factors that influence the mathematics classroom learning environment, which in turn affect the implementation of the new mathematics curriculum at the lower secondary and middle secondary schools in Bhutan. According to Namgyel (2011), there are numerous factors that constrain classrooms in Bhutanese schools, including support and motivation from the administration, inadequacy of physical facilities and basic resources, overcrowded curriculum, workload of teachers, large class size, lack of teacher competency, lack of retraining and coaching of teachers, inadequacy of teachers’ orientation and training workshops to teach new mathematics, and so on. Similarly, the findings of the study were also consistent with those of past research findings (e.g., Jamtsho, 2001; Namgyel, 2011), and in fact, some of these factors were replicated in the study. Understanding these factors is important as it can have a direct impact on teachers’ and students’ perceptions of their mathematics classroom learning environments. DenBrok, Fisher, Rickards and Bull (2005) noted that both the teachers and researchers should have knowledge on the factors that shape students’ perceptions of their classroom learning environment. This is because such knowledge may help teachers in establishing how their actions appear to their students and how learning environments can be changed in order to stimulate the learning of all students.

**Overcoming Resource Constraints.** The new standards-based school mathematics curriculum demands for a lot of material resources to be in place for all classrooms in order to support the teaching-learning process. The findings of this study indicated that a majority of teacher participants considered factors related to inadequate resources such as physical facilities, basic classroom materials, and teaching aids. In most schools, those basic teaching-learning materials have been
provided in insufficient quantity and their provision requires further reinforcement from the authorities, and organizations concerned at all levels. In addition, it was also felt necessary to enhance classroom teachers’ initiative of resourcefulness, that is, in terms of improvisation of some of those materials, which they can use in their own classrooms. Further, it might be important to seek the support of parents and the community at large in terms of providing basic materials required for preparing those classroom teaching aids.

**Enhancing Teacher Professional Development and Training.** Teacher interview participants also viewed professional development trainings and workshops for teachers to be an essential factor for the effective implementation of the new curriculum. They argued that professional development training programmes in specific subject areas have to be reinforced in Bhutanese school contexts. Otherwise, such training and workshops remain ineffective without any benefits to the students and systems. The findings of the study indicated that many teachers in the field did not receive enough professional training and orientation in regards to the implementation of the new mathematics curriculum. Teachers generally acknowledged the need for workshops or training on the implementation of the new curriculum for their professional development. Hence, this support can help them improve their classroom practices and understand the classroom learning environment in Bhutanese educational contexts, and more specifically in their teaching contexts.

**Improving Knowledge of Leadership and Administration.** Without the school leaders’ and administrators’ knowledge about mandated educational reform policies and teaching guidelines under the framework of new mathematics curriculum, it would be difficult to support their teachers and students. Some of the teachers were
of the opinion that the school systems not only require a strong progressive leadership and administration, but also one with good knowledge about the mathematics curriculum and classroom learning environment. This is because it all depends on principals’ and administrators’ knowledge about the impact of positive classroom learning environment on students’ learning and its benefits to the school system as a whole. It is very important that school leaders and principals understand the needs of the schools and expectations of their teachers and students (Chandra & Mills, 2014). In addition, school administrators have a crucial role in ensuring availability of resources and materials required for teaching and creating opportunities for teacher professional development.

*Improving Standard of Communication Skills.* Some of the teachers were of the view that the low standard of English communication skills among Bhutanese students is another challenge that makes the classroom environment difficult in Bhutanese schools. This is because the new mathematics curriculum demands a certain level of proficiency and command in the overall English language as one of its process standards. It may be due to the fact that the English is not a native language for Bhutanese students, and it is a third or fourth language for almost all of them. Although, most of the school subjects are taught in English, except for Dzongkha, the national language of Bhutan, the low standard of English language affects their learning in mathematics. Hence, it is apparent that the authorities concerned and the classroom teachers need to look for the possibility of improving the English language standards in Bhutanese schools, so that students can learn mathematics and other subjects with understanding.

*Changing Teachers’ Beliefs and Attitudes.* The teachers’ beliefs and attitudes towards the new mathematics curriculum were also seen as dominating factors,
which affect the process of curriculum implementation. It is timely for mathematics education to change, supporting the teachers in effecting that change needs to be addressed. Hence, it may serve as a useful starting point to identify teachers’ positive beliefs (Chandra & Mills, 2014) about using new pedagogy, curriculum and assessment since this provides the lens for how they see and interpret actions. Thus, teachers’ positive beliefs about moving towards a contemporary standpoint of pedagogy, process of mathematics learning, and nature of mathematics as a subject, will always enhance the potential for change.

Improving Motivation, Incentives and Rewards. Some teacher participants appeared critical of the motivation, incentives and rewards available to teachers. They felt that the lack of these opportunities has a negative impact on classroom environments and more importantly in areas where the new initiatives are implemented such as mathematics curriculum. They believed that equal opportunities should exist when it came to professional development training and workshops. This also acts as an incentive that would motivate them to put in extra effort and work harder. Some researchers have pointed out that as long as the issues of motivation, incentives and rewards are not resolved in education systems, curriculum reform agenda will always remain challenging (Kennedy, Fok, & Chan, 2006). Similarly, the situation might remain the same in regard to the effectiveness of mathematics curriculum reform in Bhutanese school context.

Encouraging Use of Technology in Mathematics Teaching. Some of the teachers were also critical of the use of technology in mathematics teaching, which has potentially a good scope in Bhutanese classrooms. If technology is a part of mathematics curriculum reform, then adequate access to appropriate information and communication technology resources needs to be provided. Some professional
development workshops may be needed to encourage classroom teachers to recognize the value of technology to support mathematical thinking and working. The comments offered by mathematics teachers suggested that overall, there is a recognition that changes need to occur in the teaching of mathematics in Bhutanese schools. However, as pointed out by Hew and Brush (2007), providing workshops and training to teachers only may not suffice, but the issue of infrastructure must be resolved in schools in terms of hardware and software along with technical support. Some other researchers were of the view that sustained use of ICT by teachers would always lead to the possibilities of fruitful learning outcomes through a shift from didactic practices towards learner-centred approaches (Chandra & Mills, 2014). In other words, the use of ICT in the classrooms has a significant role in making teaching and learning of mathematics meaningful and enjoyable to the learners. Hence, the use of technology in the form of both ‘mathematical analysis tools’ and the real world interfaces can assist in teaching and learning mathematics (Barkatsas et al., 2009).

6.3 Implications of the Research Findings

The research findings have several implications for further classroom learning environment research, schools and classroom practices, curriculum implementation, educational leadership and management, and policy and decision making. Some of these implications can be explored as follows:

6.3.1 Implications for Future Research

The current study attempted to address issues related to some major aspects of classroom learning environment but there are many other issues to be researched. This consequently leads to many implications for future research. The following are
a few areas which may be manageable, and more importantly useful for Bhutanese school contexts.

- The present study, though it laid the foundation for classroom learning environment research in Bhutanese school contexts, could focus only on eight scales of the classroom learning environment. Hence, it will be worthwhile to identify additional scales for such studies. Each of these scales deserves its own specific research, and an in-depth case study of each of them would prove useful to draw authentic views of the participants about their classroom learning environment.

- The study could not delve into the interface between the perceptions of the classroom learning environment and their impact on student learning outcomes in Bhutanese schools. Hence, a study focusing on the associations between the perceptions of learning environment and students learning outcomes or learning efficacy may prove worthwhile as shown by research in many other countries (e.g., Fraser, 1998b).

- An investigation of grade 8 students’ and teachers’ perceptions of their classroom learning environments needs to be carried out in more depth and on a larger scale than that was possible in this study. It would be worthwhile to research a larger sample size, which may provide a better picture of the classroom situation in Bhutan. Hence, the study could be replicated using different geographic areas, grade level samples, school level samples, college and university levels, education levels, school types, school localities, and so on.

- Besides, the classroom environment scales which were studied in this study, there are possibly numerous other scales or characteristics of the mathematics
classroom. The study of these additional scales of the classroom learning environment could also provide a better picture of the classroom situation of the Bhutanese secondary schools.

- Further, a longitudinal study of perceptions of classroom learning environment at three levels of secondary schools (lower, middle and higher secondary schools) would give wider and better perspectives of the issue. Additionally, a comparative study of perceptions of classroom learning environment among different subjects and discipline areas would also provide better perspectives of the classrooms in Bhutan.

6.3.2 Implications for Schools and Classroom Practices

As the findings showed certain differences between students’ and teachers’ perceptions of their classroom environments (pertaining to some MCLES scales), in terms of gender, school level and school location, there are implications for schools as well as teachers’ classroom practices. In this case, the teachers have a leadership role in classrooms, which is crucial in setting the learning environment and closing the gap between students’ and their perceptions of the classroom learning environments (Dorman, 2008; Fraser, 1998). These findings imply that classroom teachers need to consider their teaching in order to create a classroom learning environment as expected by their students.

In addition, schools must provide a sufficient time and pace for planning and assessment when any new innovations such as new curriculum, teaching approaches, and technology integration into classrooms are implemented. This is a felt necessity for classroom teachers to reconceptualise their thinking, pedagogical beliefs and work practices for time and space are needed for professional dialogue in order to develop a consensus of views (Liu, 2011; Zevenbergen, 1996).
6.3.3 Implications for Curriculum Development and Implementation

The study investigated the perceptions of the nature of the mathematics classroom learning environment in relation to the implemented new curriculum. In purpose, it also explored the perceptions of classroom learning environment with the belief that the quality of classroom environment affects the process of implementing the new curriculum significantly. Hence, the classroom learning environment becomes an important variable to understand the curriculum implementation in mathematics.

The implication is that the curriculum specialists, curriculum planners and teachers as curriculum implementers be aware about the practical requirements of curriculum implementation and recommend to the policy makers and administrative levels those requirements, such as the supply of basic classroom materials, equipment, and so on. In addition, this will also help in empowering the curriculum planners and developers to improve the curriculum documents and materials for the benefits of students and the system as a whole.

6.3.4 Implications for School Leadership and Management

The issue of the impact of implementing new curriculum on perceptions of classroom learning environment drew attention not only from the teachers and students, but also from the school administrators, who are also responsible for management of the school systems in Bhutan. It was argued that adopting a change in a system is always time-consuming and difficult, and even potentially good changes often do not necessarily fare well (Dukpa, 2000). In view of this argument, the findings of this study can be considered as significant. Hence, there is a need for Bhutanese educational administrators to foster a professional learning environment that supports teachers in the field, rather than simply directing teachers.
The findings provide significant evidence about what school leaders and management need to take into consideration. The research findings revealed that there were gaps between teachers’ perceptions of their working environment in terms of their expectations and the reality of the situations (Wahyudi, 2004). These findings may help school administrators to facilitate the schools so that teachers’ expected working environment can be accommodated, which may lead to improvement in teachers’ teaching practices and which in turn may help students learn better. In addition, the findings can inform school principals and administrators about the status of how mathematics curriculum is implemented and what the current status of mathematics curriculum achievement is.

6.3.5 Implications for Policy and Decision-making

There are implications for policy makers and system administrators both at the macro and micro levels, but the key issue that must be resolved is the need for an enlightened approach by teachers within the classroom, supported by appropriate ideas and materials from the Ministry of Education and Department of Curriculum and Research Development (Dukpa, 2000). Thus, in order to bring change and make the curriculum implementation successful in our schools with a desired effect, policy makers and all professionals in the system must consider and respond constructively to the above findings.

This study is significant for policy and decision-making in that the research study provides evidence of the process of curriculum implementation in 8th grade mathematics classes and their classroom learning environments. The findings suggest that the disparities in terms of material supplies, and curriculum implementation that exist between urban and rural schools, can be used as a point of reference for the improvement. It is recommended that the system administrators and policy makers
still need to give extra attention and support to those rural schools as well as to urban schools, which comparatively lag behind their counterparts in urban areas. Otherwise, such inconsistencies in the system will result in imbalanced growth of the schools and their poor academic performances.

This study recommends the need for policy considerations that clearly outline the importance of positive classroom learning environments in Bhutanese school contexts. These policies need to be implemented formally so that teachers can appreciate the benefits to be gained in fostering the sense of awareness about the significance of a positive learning environment. In order to help teachers, the authority concerned needs to also provide teacher training through workshops and seminars on how to improve the classroom learning environment, with sufficient resources and material supply to all the classrooms.

6.4 Contributions of the Study

It has been claimed that the classroom is a place where the actual business of learning takes place (Fraser, 1989; Fraser, Tobin & McRobbie, 2012), and for meaningful learning to occur, the classroom learning environment must be equally comfortable and enriching for both the student and the teacher (Peer, 2011). It has been argued that a secondary school student spends approximately 15,000 hours in the classroom by the time they complete their secondary education (Fraser, 2001). Hence, it is not only reasonable but essential to find out about the learning situation as perceived by participants of the classroom learning environment – that is, both the students and the teacher. The study is an attempt to explore the actual learning contexts of the Bhutanese grade 8 mathematics classrooms and has theoretical, practical and national contributions.
6.4.1 Theoretical Contributions

Firstly, this current study is significant because it extended the field of classroom learning environment research by investigating perceptions of both teachers and students of their mathematics classroom environment in the same study. Unlike many of the studies in the past, there was no singular focus – either teachers’ or students’ perceptions. Thus, it adds to the theoretical knowledge of the field of learning environment research.

Secondly, this is the first study of its kind in Bhutan that investigated the mathematics classroom environment that made the use of the two most validated and versatile existing learning instruments in the field of learning environment research, the WIHIC and CLES, by adapting them into a single study and in a new context. This can contribute towards further use, development and validation of these instruments in the new contexts such as Bhutan, adding value to them.

Thirdly, this is the first study of its kind in Bhutan that investigated classroom learning environment that was driven by curriculum reform. This study can be considered as an attempt to bring together the two fields of the classroom learning environment and curriculum, both of which are ultimately concerned with the students and their learning.

The new Bhutanese school mathematics curriculum theoretically envisages a shift from traditional to constructivist teaching practices in order to make learning in mathematics meaningful to the learners. Hence, the classroom learning environment under the framework of new mathematics curriculum should reflect constructivist views. The study contributes towards the conceptual understanding of classroom learning environment from the constructivist perspective, emphasizing the student is
at the center of the given classroom context in which the learning takes place. However, the student learning can be always understood from the perspective of both the teachers and the students since they are the key participants in the classroom environment. Hence, the study contends that the students’ and teachers’ perceptions of their classroom environments are critically important.

Within the social constructivist framework, the focus of the teaching-learning process should be the learner, and the classroom environment should allow him or her to actively participate in the learning process (Howard et al., 2009). Learning as a cognitive process can be attributed to individual cognition, which lies within the learner’s mind. However, the student’s mental processes and behaviours are always mediated by other participants in the classroom context, mainly the other students and the teacher. In other words, his or her constant interaction with the other students and the teacher has a significant role in his or her learning. Learning tasks based on the given curriculum creates opportunities for the student to interact with the other two participants – the other students and the teacher (Gray, 2005). Thus, the current study proposes a theoretical model for understanding the nature of social constructivist learning environments in Bhutanese mathematics classrooms. This model is represented in Figure 6.1.

As shown in Figure 6.1 below, in order to have a holistic view of the concept of classroom learning environment, the three key elements are important: the Teacher (A), the Learning Tasks (B), and the Other Students(C) for student learning. Given the contextual factors and the new curriculum intentions, the study positioned the student as the focus of constructivist learning process and associates him or her with the three key elements of his or her learning. In the context of this current study, the association between the student and the three key elements of learning is
explained by the perceptions of MCLES scales depending upon the nature of their relationships with him or her. In order to apply this model in other contexts or new situations, these scales can be subject to change or bring in the other aspects of the classroom environment, which can be used to explain the relationship between the learner and the other two elements from different perspectives.

Figure 6.1 A Model for Understanding Classroom Learning Environment

Firstly, the study contended that the teacher’s role as the facilitator of student learning is to provide support so that the student trusts him or her and approaches to seek support. The teacher must provide equal opportunities to the students and listen to their voices so that they develop trust and confidence in the teacher. Thus, the relationship between the student and the teacher is explained through Teacher Support (TS), Equity (EQ), and Critical Voice (CV) scales of the MCLES, and it depends on how the students and teachers perceive each of this scale. The teacher
also has a role towards student learning indirectly through other students, and learning tasks. Hence, it is the teacher’s responsibility to create stimulating learning environments and contexts, which leads to improvement in student learning (Haarala-Muhonen, Ruohoniemi, Katajavuori, & Lindblom-Ylanne, 2009). The study of teachers’ perspectives of their classroom learning environment is, therefore, viewed as essential and significant from the theoretical as well as the contextual perspectives of Bhutanese schools.

Secondly, the study proposed that in order to bring personal growth (Moos, 1974; Dorman, 2008) in the student, enhance relationship (Moos, 1974) between the student and the other students, and bring system change (Moos, 1974) in the classroom in the process of teaching and learning, it is important to associate the student to other students through psychosocial means such as cooperation, cohesiveness, and negotiation, which depend on how they perceive these scales. The interrelationship between the student and the other students is indicated by the three MCLES scales of Student Negotiation (SN), Student Cohesiveness (SC) and Cooperation (CO). These three scales can be considered important from the perspective of peer support that the student receives from his or her peers within and outside the classrooms. This peer support has a significant role in his or her learning outcomes and achievements.

Lastly, it also proposed that it is necessary to connect the curriculum and learning tasks to the student in terms of its Personal Relevance (PR) and Task Orientation (TO) based on his or her real life experiences and pre-instructional knowhow (Howard et al., 2009). In order to make the learning relevant and meaningful to the learner, learning tasks must be related to his or her real world experiences, and have clear expectations of each task. Once again the teacher’s role
towards student learning through learning tasks cannot be ignored here. The link between the student and learning tasks can be known through how the student perceives the Personal Relevance (PR) and Task Orientation (TO) scales of the MCLES. For this, the critical evaluation of learning experiences in the classrooms is necessary and important.

Thus, this theoretical model explains how the social constructivist classroom learning environment can be understood in Bhutanese schools, based on the three key elements or dimensions of human environment, which comprises relationship, personal growth and system change and maintenance (Dorman, 2008; Fraser, 1998a).

6.4.2 Practical Contributions

The practical contribution of the study is that it may enhance the ability of the classroom teachers to make mathematics learning enjoyable and meaningful to their learners by creating a positive learning environment, and changing their pedagogical orientations towards student-centered instruction. The findings of the study indicated that the teachers themselves appeared to be a constraint inhibiting learning environments in the Bhutanese contexts due to their lack of understanding about the concept and significance of classroom environment. It is recommended that there should be a clear direction of how the teachers need to understand the concept of the constructivist learning environment and how it could be manifested at the classroom level.

The findings of the study indicated that most mathematics teachers lacked professional training and orientation in regards to the implementation of the new curriculum. They themselves recognize the need for workshops or training on the implementation of the new curriculum for their professional development. Hence, this support can help the teachers improve their classroom practices and better
understand the learning atmosphere in Bhutanese educational contexts, and more specifically in the context of teaching and learning of mathematics.

The study may prove to be valuable to educational leaders, school principals, and teacher educators in Bhutan, as it will provide them insights into the impact of a positive perception of learning environment in promoting effective classroom practices. This should enable them to understand the benefits, values and impact of positive classroom learning environment, identify significant barriers in student learning and evaluate teaching practices (Centre for Educational Research & Development [CERD], 2004).

6.4.3 Contribution to Bhutan’s National Goal of GNH

Bhutan’s national goal and policy of Gross National Happiness aims to achieve happiness for its citizens mainly in terms of good governance, socio-economic development, environmental conservation, and preservation of national identity and culture (Gyabak & Godina, 2011). The current study has a small role towards this end, as it investigated the students’ and teachers’ perceptions of their classrooms, which can be associated with their happiness within the classroom context. It has been argued that “Bhutan’s macro-social policy of GNH can only be realized if it reflects happiness that exists between face-to-face interactions among the teachers and students during micro-social processes such as in the classrooms” (Rinchen, 2014, p. 274). Thus, the study contributes towards the national goal of achieving happiness among Bhutanese people by providing a snap shot of the perceptions of the participants in this study towards their mathematics classrooms. It shows an understanding can be developed about people’s perceptions and can help in conceptualizing happiness in their mathematics classroom context.
The study as a whole indicated positive perceptions of classroom learning environment which is in accord with Bhutan’s national goal of GNH philosophy. However, the statistically significant differences in the students’ and teachers’ perceptions on some of the MCLES scales, and their responses to some of the interview questions give ideas on where improvements are needed.

Therefore, it can be concluded that while the mathematics classroom environments in Bhutanese schools are perceived favourably, there is room for further improvement – to create conducive conditions for happiness (Ura, 2008) and bring a healthy social development (Gyabak & Godina, 2011). A positive perception of classroom environment by both the students and teachers indicates their happiness in the classroom, which would lead to positive interactions, emotions, positive attitudes and values (Lyubomirsky & King, 2005). If they do not perceive their classroom positively, it then indicates their unhappiness in the classrooms, which will lead to negative attitudes, and emotions.

The present study identifies associations between positive perceptions of students and teachers and their classroom happiness. It has argued that the students and teachers with more positive perceptions about their classrooms were more likely to show greater happiness in and satisfaction with their achievements and learning (Rego, Ribeiro, & Cunha, 2010). It was noted that expression, identification, and understanding of emotions are central in students’ and teachers’ effective participation during instructional interactions, which helps to create positive classroom climates (Meyer & Turner, 2006). Therefore, understanding how positive classroom learning environments develop and are sustained is essential for improving educational opportunities through quality instructional interactions, which have relationships and emotions at their core (Meyer & Turner, 2006).
6.5 Reflection on the Methodology

Since the current research study was conducted using the mixed-methods design as described in Chapter 3, it is worthwhile to reflect upon strengths as well as limitations of its methodological design and framework.

6.5.1 Strengths of the Study Methodology

This educational research, especially, the classroom learning environment research is relatively new to the Bhutanese school context, so most teachers and students were interested to participate in the study. This factor might have contributed towards a high rate of return of 75.9% for the student questionnaire and 85.2% for the teacher questionnaire (See Chapter 3, section 3.6.1 for details, p.114). This was much more than what is usually expected in the rate of return of survey questionnaires.

A variety of techniques of quantitative data analysis employed in the study were also useful. Using both the Microsoft Excel and SPSS software could analyze the huge categorical data numerically within a short span of time. Almost all the responses to questionnaire items could be viewed in terms of descriptive statistics (means and standard deviations), as well as inferential statistics (independent samples t-test, and one-way analysis of variance, effect size). In addition, the description of samples of the study could be presented in terms of the frequency and percentage distributions.

The use of mixed-methods design was found to be quite advantageous as compared to either quantitative or qualitative study, a single method of study in terms of data sources, data analyses, theories, and conclusions drawn. This research approach leads to multiple data collection and interpretations, resulting in multiple perspectives about the topic under study and enhancing the credibility of its findings.
Furthermore, the study adapted the most popular and validated research instruments, the WIHIC and CLES, which were expected to further enhance the credibility of its findings. These two instruments were used in varied contexts, among different subjects, locations, grade levels, age groups and so on. Hence, the MCLES can be considered valid and reliable research for use with the given samples.

6.5.2 Limitations of the Study

The current study has several limitations, which hold important methodological considerations for future researchers investigating classroom learning environments. First of all, the researcher wished he had involved more participants during the pilot study phase, and had done some trial analyses in order to understand the complexity and multiplicity of data collected. The study also did not employ open-ended questions in the survey questionnaire, which could have supported the comparison of quantitative and qualitative data within the survey results itself, and complemented the findings from interview data.

Another limitation of the survey study is in regard to the selection of the samples. Both the teacher and the student samples for the study came only from selected public lower secondary and middle secondary schools, from two districts in western Bhutan. Hence, it is unclear whether the findings from the present study can be generalized more widely beyond the contexts of those participating schools.

The scope of the qualitative part of this study was restricted to six focus group interviews with 31 students and five individual interviews with the teachers. In order to fully understand the results of the survey questionnaire, it would have been preferable to conduct much more comprehensive qualitative data collection than was possible in the study. Besides, qualitative data collection was found difficult because
the students who were chosen for the focus-group discussion were hesitant to give frank views about their experiences of learning mathematics. It was particularly difficult to get information concerning what they felt about their teachers and mathematics lessons, as students are culturally often reserved in nature in Bhutanese classrooms.

The qualitative data also revealed that the MCLES or its original version of both the WIHIC and CLES have proven to be useful methods for providing significant insights into the “key characteristics of teaching epistemologies” (Aldridge, Fraser, Taylor & Chen, 2000, p.53) in mathematics classrooms in Bhutanese secondary schools. However, the findings indicated that precaution is advisable regarding the use of research instruments developed in a Western context, such as survey questionnaires or interview protocols developed in a country like Bhutan. This is because the interpretation of data which measures classroom learning environment from a Western viewpoint could be limited if sociocultural factors are strictly taken into account. Thus, generalization of the research findings for all contexts and different cultures may prove to be faulty and their validity might be questionable, as the cultural norms within a system make it very difficult to strike a power balance in the classroom between the teacher and students.

6.6 Concluding Remarks

This current study was an investigation into Bhutanese 8th grade students’ and teachers’ perceptions of their mathematics classroom learning environment. It was the first study to make use of the most validated learning environment instruments (WIHIC and CLES) in Bhutanese school contexts. The perceptions of mathematics classroom environments were successfully investigated employing the ‘Quan-Qual model’ of mixed-methods with surveys and interviews as the data sources, and whereby
information gathered was sequentially analyzed (Namgyel, 2011). The study also discussed and analyzed the quantitative and qualitative data to complement credibility of their findings altogether, and attempts were made to link them with the available literature to make meanings and draw valid conclusions.

The study has contributed the first findings on how students and teachers perceived their mathematics classroom learning environments from the perspective of the new curriculum in Bhutan. We now have base samples that allow us to see how important the classroom situation is in teaching and learning of mathematics. The study also informs us about how Bhutanese eighth grade students and their teachers feel about their learning environment. It is hoped that other research studies will follow to add to these samples so that we can have a holistic picture of the classroom situation across all schools in Bhutan, and so that we contribute to improving the quality of mathematics education in our schools.

This study shows that the implementation of the new mathematics curriculum in Bhutanese schools is seen to offer considerable potentials for enhancement, engagement and motivation for quality student learning in mathematics. In other words, there are practical benefits of this curriculum reform, which is based on a social constructivist approach to teaching and learning of mathematics, and this would guarantee improvement in the quality of mathematics education in the country. However, in such a context, for its greater success, it is important to address a number of contextual issues, which may not be quickly or easily overcome.

Lastly, the study has made a worthwhile contribution to the field of learning environment research, providing an in-depth understanding of students’ and teachers’ perceptions about mathematics learning environment and how their perceptions align with teaching practices in Bhutanese schools, and the intentions of the school
mathematics curriculum. Its findings could be used by fellow mathematics teachers in Bhutan to guide the development of more positive classroom learning environments. All in all, it is hoped that Bhutanese students will always be motivated and happy to learn mathematics in a classroom that is teacher supported, cohesive, task-oriented, cooperative, and equitable in nature; an environment that, with critical, relevant and negotiable mathematics learning, contributes in its own little ways to Bhutan’s national goal of ‘Gross National Happiness.’ Thus, the study provides the way forward to improving student learning in mathematics by contributing theoretically and practically towards better understanding of the classroom situation in Bhutanese schools.
References


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References 287


Martin-Dunlop, C. S., & Fraser, B. J. (2004). *Learning science can be fun: Changing future elementary teachers' ideas about laboratory learning environment and


Peer, J. (2011). *Gender, Grade-level and Stream Differences in Learning Environment and Student Attitudes in Primary Science Classrooms in Singapore*. (PhD Monograph), Curtin University of Technology, Perth.


Priest, D. J. (2009). *A problem-posing intervention in the development of problemsolving competence of underachieving, middle year students*. (PhD), Queensland University of Technology, Brisbane.


Wahyudi. (2004). *Educational practices and learning environments in rural and urban lower secondary science classrooms in Kalimantan Selatan Indonesia.* (Doctor of Science Education Monograph), Curtin University of Technology, Perth.


Appendices

Appendix A: Participant Information and Consent Forms

PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT
–Questionnaire (Students) –

Investigating Perceptions of Classroom Learning Environment in Bhutanese Lower Secondary Schools from the Perspective of New Mathematics Curriculum

QUT Ethics Approval Number: 1300000360

RESEARCH TEAM

Principal Researcher: Rinchen Tshewang, PhD student, QUT
Dr. Vinesh Chandra, Principal Supervisor, QUT and
Dr. Andy Yeh, Associate Supervisor, QUT.

DESCRIPTION

This project is being undertaken as part of a Doctor of Philosophy (PhD) study by Rinchen Tshewang, a PhD student, at the Queensland University of Technology, Australia.

The purpose of this study is to find out what your opinions are about your mathematics classroom. More importantly the researcher is interested in finding more about how the new curriculum is impacting on learning environment.

You are invited to participate in this project because as a student you know a lot about your mathematics classrooms. In fact, you are the best judge of your own experiences of your mathematics classroom environment and what the mathematics learning is like for you.

PARTICIPATION

Your participation in this project is entirely voluntary. You can also withdraw from the project at any time, without comment or penalty. Any identifiable information which will be obtained from you will be destroyed. Your decision to participate or not participate will in no way impact upon your current or future relationship with the university, or with your grades for school assessment.

Your participation will involve completing a questionnaire (of 48 items) that will take approximately 15 minutes of your time. Items in the questionnaire will include for example, under the scale Teacher Support, “My teacher goes out his way to help me in this class” and under Involvement, “I give my opinions during class discussions,” etc. For each of these items there are five alternative responses of ‘Never’, ‘Seldom,’ ‘At times,’ ‘Often’ and ‘Always’ which are indicated by the numbers from (1 to 5) respectively.

If you agree to participate you do not have to complete any question(s) that you are uncomfortable answering.
EXPECTED BENEFITS
It is expected that this project will not directly benefit you. However, it may benefit teachers in future as the results of the study will help the researcher draw certain insights about classroom situation in Bhutanese schools in reference to new mathematics curriculum. Through the project the researcher hopes to make recommendations for improving mathematics classroom learning environments.

RISKS
There are minimal risks associated with your participation in this project. These include disturbance of your time, and privacy. It may be minimised if you choose to participate at your own convenience during your break time or after your class hours.

PRIVACY AND CONFIDENTIALITY
All comments and responses are anonymous and will be treated confidentially. Your names are not required to mention in any of the responses. Even your school names will remain confidential and they will replace with replacement names.

Any data collected as part of this project will be stored securely as per QUT’s management of research data policy.

CONSENT TO PARTICIPATE
The return of the completed questionnaire is accepted as an indication of your consent to participate in this project.

QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT
If you have any questions or require any further information please contact any of the research team.

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CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT
QUT is committed to research integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on [+61 7] 3138 5123 or email ethicscontact@qut.edu.au. The QUT Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Thank you for helping with this research project. Please keep this sheet for your information.
PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT
–Group Interview (Students)–

Investigating Perceptions of Classroom Learning Environment in Bhutanese Lower Secondary Schools from the Perspective of New Mathematics Curriculum

QUT Ethics Approval Number: 1300000360

RESEARCH TEAM

Principal Researcher: Rinchen Tshewang, PhD student, QUT
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DESCRIPTION

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You are invited to participate in this project because as a student you know a lot about your mathematics classrooms. In fact, you are the best judge of your own experiences of your mathematics classroom environment and what the mathematics learning is like for you.

PARTICIPATION

Your participation in this project is entirely voluntary. You can also withdraw from the project at any time, without comment or penalty. Any identifiable information already obtained from you will be destroyed. Your decision to participate or not participate will in no way impact upon your current or future relationship with Paro College of Education or Queensland University of Technology, or with your grades for school assessment.

Your participation will involve an audio recorded group interview at your school campus or other agreed location. It will take approximately 30-40 minutes of your time. Some of the questions which will be included in the interview are:

1. Tell me something about your mathematics classrooms as a learning place?
2. What support do you get from your teachers and friends in learning mathematics?
3. Could you tell about group works and pair works you do in your mathematics class?
4. Tell me about how you all share your materials among yourselves.

5. What opportunities do you have in working with friends in mathematics class?

6. How does your teacher give you attention in learning mathematics? How are you treated by your fellow friends in mathematics class?

7. What are the things that hamper your learning in mathematics?

8. What could be some possible things that really help you learn mathematics better?

If you agree to participate you do not have to answer any question(s) that you are uncomfortable answering.

**EXPECTED BENEFITS**

It is expected that this project will not directly benefit you. However, it may benefit teachers in future as the results of the study will help the researcher draw certain insights into classroom situation in schools in Bhutan in reference to new mathematics curriculum. Through the project the researcher hopes to make recommendations for improving classroom learning environments.

**RISKS**

There are minimal risks associated with your participation in this project. These include disturbance of your actual class, your time, and privacy. It may be minimised if you choose to participate during your break time or after your class hours.

**PRIVACY AND CONFIDENTIALITY**

All comments and responses are anonymous and will be treated confidentially. Your names are not required to mention in any of the responses. Even your school names will remain confidential and they will replace with replacement names.

Any data collected as part of this project will be stored securely as per QUT’s Management of research data policy.

Since the study involve audio recording you will have the opportunity to verify your comments and responses prior to final inclusion. The audio recording will be destroyed only after the completion of the project. In case your audio recording will be used for any purpose, I will seek your permission prior to its use. However, confidentiality and anonymity of your voice will be maintained to the best of my ability. If need be it is possible to participate in the project without being audio recorded as well, in which case I will rely on my interview schedule.

**CONSENT TO PARTICIPATE**

I would like to ask you to sign a written consent form (enclosed) to confirm your agreement to participate in this group interviews.
QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT
If you have any questions or require any further information please contact one of the research team members below.

Mr. Rinchen Tshewang, Lecturer
Paro College of Education, Paro: Bhutan.
Phone: 975 17741511
Email: rinchen.tshewang@qut.student.edu.au

Dr. Vinesh Chandra, Senior Lecturer
School Sci, Math & Technology Education
Faculty of Education, QUT
Phone: +6107 3188 3339
Email: v.chandra@qut.edu.au

Dr. Andy Yeh, Senior Lecturer
School of Sci, Math & Technology Education
Faculty of Education, QUT
Phone: +6107 3188 3339
Email: v.chandra@qut.edu.au

CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT
QUT is committed to research integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on [+61 7] 3138 5123 or email ethicscontact@qut.edu.au. The QUT Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Thank you for helping with this research project. Please keep this sheet for your information.
CONSENT FORM FOR QUT RESEARCH PROJECT
– Group Interview (Students) –

Investigating Perceptions of Classroom Learning Environment in Bhutanese Lower Secondary Schools from the Perspective of New Mathematics Curriculum

QUT Ethics Approval Number: 1300000360

RESEARCH TEAM CONTACTS

Mr. Rinchen Tshewang, Lecturer
Paro College of Education,
Royal University of Bhutan
Mobile: 975 17741511
Email: rinchen.tshewang@student.qut.edu.au

Dr. Vinesh Chandra, Senior Lecturer
School Sci, Math & Technology Education
Faculty of Education, QUT
Phone: +6107 3188 3339
Email: v.chandra@qut.edu.au

Dr. Andy Yeh, Senior Lecturer
School of Sci, Math & Technology Education
Faculty of Education, QUT
Phone:
Email:

STATEMENT OF CONSENT

By signing below, you are indicating that you:

- Have read and understood the information document regarding this project.
- Have had any questions answered to your satisfaction.
- Understand that if you have any additional questions you can contact the research team.
- Understand that you are free to withdraw at any time, without comment or penalty.
- Understand that you can contact the Research Ethics Unit on [+61 7] 3138 5123 or email ethicscontact@qut.edu.au if you have concerns about the ethical conduct of the project.
- Understand that the project will include an audio recording.
- Agree to participate in the project.

Please tick the relevant box below:

☐ I agree for the group interview to be audio recorded.
☐ I do not agree for the group interview to be audio recorded.

Name: …………………………………………………………………………………………………………..

Signature: ………………………………………………………………………………………………………

Date: ………………………………………………………………………………………………………….
STATEMENT OF CHILD CONSENT

Your parent or guardian has given their permission for you to be involved in this research project. This form is to seek your consent to participate in the research.

By signing below, you are indicating that you:

- Have read and understood the information about this project.
- Have discussed the project with your parent/guardian.
- Have had any questions answered to your satisfaction.
- Understand that if you have any additional questions you can contact the research team.
- Understand that you are free to withdraw at any time, without comment or penalty.
- Understand that you can contact the Research Ethics Unit on [+61 7] 3138 5123 or email ethicscontact@qut.edu.au if you have concerns about the ethical conduct of the project.
- Understand that the project will include an audio recording.
- Agree to participate in the project.

Please tick the relevant box below:

☐ I agree for the group interview to be audio recorded.
☐ I do not agree for the group interview to be audio recorded.

Name: ...........................................................................................................
Signature: ....................................................................................................
Date: ..........................................................................................................  

MEDIA RELEASE PROMOTIONS

From time to time, we may like to promote our research to the general public through, for example, newspaper articles. Would you be willing to be contacted by QUT Media and Communications for possible inclusion in such stories? By ticking this box, it only means you are choosing to be contacted – you can still decide at the time not to be involved in any promotions.

☐ Yes, you may contact me about inclusion in promotions.
☐ No, I do not wish to be contacted about inclusion in promotions.

Please return this sheet to the investigator.
RESEARCH TEAM

Principal Researcher: Rinchen Tshewang, PhD student, QUT
Dr. Vinesh Chandra, Principal Supervisor, QUT and Dr. Andy Yeh, Associate Supervisor, QUT.

DESCRIPTION

This project is being undertaken as part of a Doctor of Philosophy (PhD) study by Rinchen Tshewang, a PhD student, at the Queensland University of Technology, Australia.

The purpose of this study is to find out what your opinions are about your mathematics classrooms. More importantly the researcher is interested in finding more about how the new mathematics curriculum is impacting on the learning environment.

You are invited to participate in this project because as a teacher you know a lot about your mathematics classrooms. In fact, you are the best judge of your own experiences of your mathematics classroom environment and what is the mathematics teaching like for you.

PARTICIPATION

Your participation in this project is entirely voluntary. You can also withdraw from the project at any time, without comment or penalty. Any identifiable information already obtained from you will be destroyed. Your decision to participate or not participate will in no way impact upon your current or future relationship with the university.

Your participation will involve an audio recorded semi-structured interview at your school campus or other agreed locations that will take approximately 30-40 minutes of your time. Some of the questions which will be included in the interview are:

1. Tell me something about mathematics classrooms as a learning place for your students.
2. How do you try to support your students to make them learn mathematics better? What support do you get from your colleagues and school management in doing so?
3. Could you tell about group works and pair works they do in your mathematics?
4. Tell me about how your students share their resources among themselves.
5. What role do you give to your students in their learning of mathematics?
6. What opportunities do your students have in working with their friends in mathematics class?
7. How do you treat your all of your students in the process of teaching mathematics?
8. What are some of the factors which hamper your teaching in mathematics? What are some of the things that support you in teaching mathematics?

If you agree to participate you do not have to answer any question(s) that you are uncomfortable answering.

EXPECTED BENEFITS

It is expected that this project will not directly benefit you. However, it may benefit you as a teacher in future as the results of the study will help the researcher draw certain insights into classroom situation in schools in Bhutan in reference to new mathematics curriculum. Through the project the researcher hopes to make recommendations for improving mathematics classroom learning environments.

RISKS

There are minimal risks associated with your participation in this project. These include disturbance of your actual class, your time, and privacy. It may be minimised if you choose to participate during your break time or after your class hours.

PRIVACY AND CONFIDENTIALITY

All comments and responses are anonymous and will be treated confidentially. Your names are not required to mention in any of the responses. Even your school names will remain confidential and they will replace with replacement names.

Any data collected as part of this project will be stored securely as per QUT’s management of research data policy.

Since the study involve audio recording you will have the opportunity to verify your comments and responses prior to final inclusion. The audio recording will be destroyed only after the completion of the project. In case, your audio recordings will be used for any other purpose, I will seek your permission prior to its use. However, confidentiality and anonymity of your voice will be maintained to the best of my ability. If need be it is possible to participate in the project without being audio recorded as well, in which case I will rely on my interview schedule.

CONSENT TO PARTICIPATE

I would like to ask you to sign a written consent form (enclosed) to confirm your
agreement to participate in this face-to-face individual interviews.

**QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT**

If you have any questions or require any further information please contact one of the research team members below.

Mr. Rinchen Tshewang, Lecturer  
Paro College of Education, Paro: Bhutan.  
Phone: 975 17741511  
Email: rinchen.tshewang@student.qut.edu.au

---

**CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT**

QUT is committed to research integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on [+61 7] 3138 5123 or email ethicscontact@qut.edu.au. The QUT Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

*Thank you for helping with this research project. Please keep this sheet for your information.*
WITHDRAWAL OF CONSENT FOR QUT RESEARCH PROJECT

Investigating Perceptions of Classroom Learning Environment in Bhutanese Lower Secondary Mathematics Classrooms from the Perspective of New Mathematics Curriculum

QUT Ethics Approval Number: 1300000360

RESEARCH TEAM CONTACTS

Mr. Rinchen Tshewang, Lecturer
Paro College of Education
Paro Bhutan
Phone: +975 17741511
Email: rinchen.tshewang@student.qut.edu.au

Dr. Vinesh Chandra, Senior Lecturer
School Sci, Math & Technology Education
Faculty of Education, QUT
Phone: +6107 3188 3339
Email: v.chandra@qut.edu.au

Dr. Andy Yeh, Senior Lecturer
School of Sci, Math & Technology Education
Faculty of Education, QUT
Phone:
Email:

I hereby wish to WITHDRAW my consent to participate in the research project named above.
I understand that this withdrawal WILL NOT jeopardise my relationship with Queensland University of Technology.

Name:..............................................................................................................

Signature:...........................................................................................................

Date:...............................................................................................................
University Human Research Ethics Committee (UHREC)
HUMAN RESEARCH ETHICS APPROVAL CERTIFICATE
NHMRC Registered Committee Number EC00171

Date of Issue: 9/2/15 (supersedes all previously issued certificates)

Dear Mr Rinchen Tshewang,

This approval certificate serves as your written notice that the proposal has met the requirements of the National Statement on Ethical Conduct in Human Research and has been approved on that basis. You are therefore authorised to commence activities as outlined in your application, subject to any specific and standard conditions detailed in this document.

Project Details

Category of Approval: Human Negligible-Low Risk
Approved From: 10/06/2013
Approved Until: 10/06/2016 (subject to annual reports)
Approval Number: 1300003350
Project Title: Investigating perceptions of classroom learning environment in Bhutanese lower secondary schools from the perspective of New Mathematics Curriculum

Investigator Details

Chief Investigator: Mr Rinchen Tshewang
Other Staff/Students:
Investigator Name: Dr Vinesh Chandra
Role: Internal
Type: Supervisor
Investigator Name: Dr Andy Yeh
Role: Internal
Type: Supervisor

Conditions of Approval

Specific Conditions of Approval:
None apply

Standard Conditions of Approval:
2. Gain UHREC approval for any proposed variation (http://www.orei.qut.edu.au/human/var/) to the project prior to implementation;
3. Respond promptly to the requests and instructions of UHREC;
4. Immediately advise the Office of Research Ethics and Integrity (http://www.orei.qut.edu.au/human/adv/) if:
   o any unforeseen development or events occur that might affect the continued ethical acceptability of the project;
   o any complaints are made, or expressions of concern are raised, in relation to the project;
   o the project needs to be suspended or modified because the risks to participants now outweigh the benefits;
   o a participant can no longer be involved because the research may harm them; and
5. Report on the progress of the approved project at least annually, or at intervals determined by UHREC. The Committee may also choose to conduct a random audit of your project.

If any details within this Approval Certificate are incorrect please advise the Research Ethics Unit within 10 days of receipt of this certificate.

End of Document
Appendix B: Approvals and Consent Letters

ROYAL GOVERNMENT OF BHUTAN
MINISTRY OF EDUCATION
DEPARTMENT OF SCHOOL EDUCATION

THIMPHU: BHUTAN

Ref: MoE/DSE/01/2013 /g 257  18 February 2013

To Whom It May Concern

Mr. Rinchen Tshewang, Lecturer, Paro College of Education, Paro is undertaking a research on the topic “Investigating perceptions of mathematics classroom learning environment in Bhutanese lower secondary schools from the perspective of New Math Curriculum”. This research is conducted as a fulfilment for his Ph.D at Queensland University of Technology, Brisbane, Australia under the RECSC-QUT scholarship and it requires the involvement of principals, teachers and students.

Therefore, all the concerned school heads and teachers are requested to facilitate Mr. Rinchen Tshewang’s work as deemed appropriate.

(Karma Tshewa)  
DIRECTOR
TO WHOM IT MAY CONCERN

Me Rinchen Tshewang Lecturer, Paro College of Education, Paro is undertaking a research on the topic "Investigating perceptions of mathematics classroom learning environment in Bhutanese lower secondary school from the perspective of New Math Curriculum". The research is conducted as a fulfillment for his Ph.D at Queensland University of Technology, Brisbane, Australia under RCSC – QUT scholarship and it requires the involvement of principals, teachers and students.

Therefore, all the concern school heads and teachers are requested to facilitate Mr. Rinchen Tshewang’s work as deemed appropriate.

(Ugyen Tshering )
Oftg. TEO
Thimphu Thronde

Date: 19.4.2013
TO WHOM IT MAY CONCERN

This is to inform that Mr. Rinchen Tshewang, Lecturer, Paro College of Education, Paro, currently undergoing Ph.D. studies at Queensland University of Technology, Brisbane, Australia is in collection of data from April to August 2013 for his research in "Investigating perceptions of mathematics classroom learning environment in Bhutanese lower secondary schools from the perspective of New Math Curricula". You may allow him to do any research work/information to be collected from the teachers and students from your schools to enable him to fulfill his research work.

(Norbu Gyeltshen)

DEO

Dzongkhag Edn. Officer

Dzongkhag Administration

PARO
To
Mr Rinchen Tshewang
Ph.D Student
School of Mathematics, Science & Technology Education
Faculty of Education, QUT, Australia

Subj: Letter of Approval

Sir,
This is in response to your letter dated 19.03.2013 seeking approval to use curriculum documents and to involve officials from this office.
You can accordingly use curriculum documents and also involve curriculum officials as per their willingness and convenience to support your research data only.
Thanking you.

Yours faithfully,

Kinley Sangyel
Chief

CC:
1. The Director, DCRD, MoE for kind information
2. Office
Letter of Consent to Director, Department of Schools Education, Ministry of Education

February 18, 2013

The Director,

Department of School Education,

Ministry of Education

Thimphu: Bhutan

Subject: Seeking Approval for Research Data Collection in Schools

Respected Sir,

I am Rinchen Tshewang, a lecturer in mathematics education working at Paro College of Education, Royal University of Bhutan, and a full-time external Ph.D candidate, studying at Queensland University of Technology, Brisbane, Australia.

The research topic that I have chosen for my thesis is “Investigating perceptions of mathematics classroom learning environment in Bhutanese lower secondary schools from the perspective of New Math Curriculum.” The research explores mainly students’ and teachers’ views about their mathematics classroom environment in reference to New Mathematics Curriculum. The study intends to involve students, teachers, and principals of selected lower secondary schools, and curriculum specialists as the participants. Besides, I would like to pilot test my research instrument (survey questionnaire) and do trial-run of my interviews and class observations with some teachers and students of selected schools at Paro district. The data gathering tools to be employed are questionnaire, interviews and class observations, and documents.

Therefore, I would be grateful to your honour, if kind approval is granted to complete this important part of my research at the earliest possible.

Thanking You,

Yours faithfully,

(RinchenTshewang),
Ph.D Student
School of Mathematics, Science & Technology Education, Faculty of Education, Queensland University of Technology, Australia
Letter of Consent to District Education Officers

Date: …………………………………..
The District Education Officer, 
District Administration:………………………….. 
………………………………………….: Bhutan 

Subject: Seeking approval for research data collection in schools 

Respected Sir,

I am Rinchen Tshewang, a lecturer in mathematics education working at Paro College of Education, under the Royal University of Bhutan, and a full-time external Ph.D candidate, at Queensland University of Technology, Brisbane, Australia.

The research topic I am working on for my PhD thesis is “Investigating perceptions of classroom learning environment in Bhutanese lower secondary schools from the perspective of New Math Curriculum.” The research explores mainly the change in students’ and teachers’ views about their mathematics classroom environment in reference to New Mathematics Curriculum.

The study intends to involve students, teachers, and principals or vice principals of selected secondary schools, as the participants. Besides, I need to pilot test my research instrument (survey questionnaire) and do trial-run of my interviews and class observations with some teachers and students of selected schools. The data gathering will take place during April-August, 2013.

Therefore, I would remain grateful to Sir, if kind approval is granted to complete this important part of my research on time. And I assure that the data collected will be managed in accordance with QUT research data management policy to the best my knowledge and ability.

Thanking You,

Yours faithfully,

(RinchenTshewang)
Ph.D Student 
School of Mathematics, Science & Technology Education, 
Faculty of Education, 
Queensland University of Technology, Australia
Letter of Consent to Chief, Secondary Curriculum Division

The Chief Curriculum Officer,
Secondary Curriculum Division,
Department of Curriculum & Research Development,
Paro: Bhutan

Subject: Seeking approval to use curriculum documents as part of research data collection

Dear Madam/Sir,

I am Rinchen Tshewang, a lecturer in mathematics education working at Paro College of Education, under the Royal University of Bhutan, and a full-time external PhD candidate, studying at Queensland University of Technology, Brisbane, Australia.

The research topic that I have chosen for my thesis is “Investigating perceptions of mathematics classroom learning environment in Bhutanese lower secondary schools from the perspective of New Math Curriculum.” The research aims to explore mainly students’ and teachers’ views about their mathematics classroom environment in reference to New Mathematics Curriculum. The study intends to involve curriculum specialists as the participants. Besides, I would like to review curriculum documents (School Mathematics Curriculum Framework, Teachers’ Guide, and Class 8 Textbook – Understanding Mathematics) to support my other research data. The data gathering tools to be employed are questionnaire, interviews and class observation, and document reviews.

Therefore, I would remain grateful to your good office, if kind approval is granted to complete this important part of my research at the earliest possible. And I assure that the data collected will be managed in accordance with QUT research data management policy to the best my knowledge and ability.

Thanking You,

Yours faithfully,

(Rinchen Tshewang)
Ph.D Student
School of Mathematics, Science & Technology Education,
Faculty of Education,
Queensland University of Technology, Australia
Letter of Consent to School Principals

Date:…………

The Principal,

XXXXXXX

CCCCCCC

Subject: Seeking Approval for Research Data Collection in Your Schools

Dear Sir,

I am Rinchen Tshewang, a lecturer in mathematics education, currently working at Paro College of Education, Paro, Royal University of Bhutan, and a full-time external, Ph.D candidate at Queensland University of Technology, Brisbane, Australia.

The research topic I am working on for my Ph.D thesis is “Investigating perceptions of classroom learning environment in Bhutanese lower secondary schools from the perspective of New Math Curriculum.” The research will explore mainly students’ and teachers’ perceptions about their mathematics classroom environment in reference to New Mathematics Curriculum.

The study intends to involve students, and teachers of class VIII from your school as the participants. They will mainly participate in survey questionnaire, and some of them will be involved in group interviews, and class observations. Before I start the actual data collection, I would also like to have a preliminary visit to your school, that is, to build rapport with teachers and students, and to have some idea about the school and classroom situations.

Therefore, I would remain grateful to your goodself, if due approval is granted to me to visit the school, and I assure that the data gathered will be used and managed in strict conformity to QUT research data management policy.

Thanking You,

Yours faithfully,

(RinchenTshewang), Ph.D Student
School of Mathematics, Science & Technology Education, 
Faculty of Education, 
Queensland University of Technology, Australia
Appendix C: Student Version of MCLES Questionnaire

Dear Students,

This survey questionnaire contains statements about practices which could take place in your mathematics classroom. Think of how best each of these sentences describes your mathematics classroom environment and how often each practice takes place. There are no right and wrong answers. Your frank view is wanted. Your responses will be kept confidential.

There are 40 items (sentences) in the questionnaire and you need to respond to each of them. Circle only one number from (1 to 5), corresponding to your answer (“Never,” “Seldom,” “At times,” “Often,” and “Always”) for each item. Before you start, indicate your gender, school level, and school location by ticking in one appropriate box below:

a. Gender : Male [ ] Female [ ]

b. School level: LSS [ ] MSS [ ]

c. School location: Urban [ ] Semi-urban [ ] Rural [ ]

Now start to respond to all the statements below.

<table>
<thead>
<tr>
<th>Scales/Items</th>
<th>Scale Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I). TEACHER SUPPORT</td>
<td></td>
</tr>
<tr>
<td>1. My teacher takes a personal interest in me in this class.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. The teacher goes out of his/her way to help me.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. The teacher helps me with my school works.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. The teacher cares about how much I learn in this class.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5. The teacher wants me to do my best in my school works.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>II). STUDENT COHESIVENESS</td>
<td></td>
</tr>
<tr>
<td>6. I know all other students in this class.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>7. I am friendly to all members of this class.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>8. I get help from all my classmates.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>9. I work well with all my classmates.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>10. I help others who have problems with their works.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>III). TASK ORIENTATION</td>
<td></td>
</tr>
<tr>
<td>11. It is important for me to complete given tasks on time.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>12. I do as much as I set out to do in this class.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>13. I know what I am trying to accomplish in this class.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>14. I try to understand the work in this class.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>15. I know how much work I have to do in this class.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>IV). COOPERATION</td>
<td></td>
</tr>
</tbody>
</table>
16. I work with all other students to achieve class goals. | 1 | 2 | 3 | 4 | 5  
17. I share my resources with other students when doing assignments. | 1 | 2 | 3 | 4 | 5  
18. I find there is sense of team work, when I work in groups. | 1 | 2 | 3 | 4 | 5  
19. I cooperate with other students on many class activities. | 1 | 2 | 3 | 4 | 5  
20. I learn from all other students in this class. | 1 | 2 | 3 | 4 | 5  

V). EQUITY

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Seldom</th>
<th>At times</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
</table>
21. I get same amount of help from the teacher as do other students. | 1 | 2 | 3 | 4 | 5  
22. I have the same amount of say in this class as other students. | 1 | 2 | 3 | 4 | 5  
23. I am treated the same as other students in this class. | 1 | 2 | 3 | 4 | 5  
24. I get the same encouragement from the teacher as other students. | 1 | 2 | 3 | 4 | 5  
25. I get the same opportunity to contribute to class discussions as other students. | 1 | 2 | 3 | 4 | 5  

VI). CRITICAL VOICE

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Seldom</th>
<th>At times</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
</table>
26. It’s OK for me to ask the teacher “Why do I have to learn this?” | 1 | 2 | 3 | 4 | 5  
27. I can question the way I am being taught in this class. | 1 | 2 | 3 | 4 | 5  
28. I can complain about activities that are confusing. | 1 | 2 | 3 | 4 | 5  
29. I can complain about anything that prevents me from learning. | 1 | 2 | 3 | 4 | 5  
30. Its’ OK for me to express my opinions in this class. | 1 | 2 | 3 | 4 | 5  

VII). PERSONAL RELEVANCE

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Seldom</th>
<th>At times</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
</table>
31. I learn about the world outside of school in this class. | 1 | 2 | 3 | 4 | 5  
32. I learn how math can be part of my real life in this class. | 1 | 2 | 3 | 4 | 5  
33. What I learn, I can link to what I already know. | 1 | 2 | 3 | 4 | 5  
34. I get better understanding of the world outside of school. | 1 | 2 | 3 | 4 | 5  
35. I learn interesting things about the life outside of school. | 1 | 2 | 3 | 4 | 5  

VIII). STUDENT NEGOTIATION

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Seldom</th>
<th>At times</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
</table>
36. I get the chance to talk to other students in this class. | 1 | 2 | 3 | 4 | 5  
37. I talk with other students about how to solve problems. | 1 | 2 | 3 | 4 | 5  
38. I explain my ideas to other students in this class. | 1 | 2 | 3 | 4 | 5  
39. I ask other students to explain their ideas to me. | 1 | 2 | 3 | 4 | 5  
40. Other students listen carefully my ideas to them. | 1 | 2 | 3 | 4 | 5  

*************** Thank You for your Support & Participation!***************
Appendix D: Teacher MCLES Questionnaire

Dear Sirs/Madams,

This survey questionnaire contains statements about practices which could take place in your mathematics classroom. Think of how best each of these statements describe your mathematics classroom environment and how often each practice takes place. There are no right and wrong answers. Your frank view is wanted. Your responses will remain confidential.

There are 40 items in the questionnaire, and you need to respond to each of them. Circle only one number from (1 to 5), corresponding to your answer (“Never,” “Seldom,” “At times,” “Often,” and “Always”) for each item. Before you start, indicate your gender, school level, and school location by ticking in one appropriate box below:

- Gender: Male ☐ Female ☐
- School level: LSS ☐ MSS ☐
- School location: Urban ☐ Semi-urban ☐ Rural ☐

Now start to respond to all the statements below.

<table>
<thead>
<tr>
<th>Scales/Items</th>
<th>Scale Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I). TEACHER SUPPORT</td>
<td></td>
</tr>
<tr>
<td>1. I take a personal interest in my students in this class.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>2. I go out of my way to help my students.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>3. I help my students with their school works.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>4. I care about how much my students learn in this class.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>5. I want my students to do their best in their school works.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
</tbody>
</table>

II). STUDENT COHESIVENESS

<table>
<thead>
<tr>
<th></th>
<th>Scale Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. My students know each other in this class.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>7. They are friendly to each other in this class.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>8. They get help from one another in their works.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>9. They work well with all of their classmates.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>10. They help who have problems with their school works.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
</tbody>
</table>

III). TASK ORIENTATION

<table>
<thead>
<tr>
<th></th>
<th>Scale Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. My students know it is important for them to complete given tasks on time.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>12. They do as much as they set out to do in this class.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>13. They know what they are trying to accomplish in this class.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>14. They try to understand the work in this class.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>15. They know how much work they have to do in this class.</td>
<td>Never 1 Seldom 2 At times 3 Often 4 Always 5</td>
</tr>
<tr>
<td>IV). COOPERATION</td>
<td>Never</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>16. Students work with all other students to achieve class goals.</td>
<td>1</td>
</tr>
<tr>
<td>17. They share their resources with other students when doing assignments.</td>
<td>1</td>
</tr>
<tr>
<td>18. They find there is sense of team work, when they work in groups.</td>
<td>1</td>
</tr>
<tr>
<td>19. They cooperate with other students on many class activities.</td>
<td>1</td>
</tr>
<tr>
<td>20. They learn from each other in this class.</td>
<td>1</td>
</tr>
<tr>
<td>V). EQUITY</td>
<td>Never</td>
</tr>
<tr>
<td>21. I give the same amount of help to all my students in the class.</td>
<td>1</td>
</tr>
<tr>
<td>22. All my students have the same amount of say in this class.</td>
<td>1</td>
</tr>
<tr>
<td>23. I treat all my students equally in this class.</td>
<td>1</td>
</tr>
<tr>
<td>24. I give the same encouragement to all my students.</td>
<td>1</td>
</tr>
<tr>
<td>25. I give them the same opportunity to contribute to class discussions.</td>
<td>1</td>
</tr>
<tr>
<td>VI). CRITICAL VOICE</td>
<td>Never</td>
</tr>
<tr>
<td>26. It's OK for my students to ask me “Why do I have to learn this?”</td>
<td>1</td>
</tr>
<tr>
<td>27. They can question the way they are being taught.</td>
<td>1</td>
</tr>
<tr>
<td>28. They can complain about activities that are confusing.</td>
<td>1</td>
</tr>
<tr>
<td>29. They can complain about anything that prevents them from learning.</td>
<td>1</td>
</tr>
<tr>
<td>30. Its’ OK for my students to express their opinions.</td>
<td>1</td>
</tr>
<tr>
<td>VII). PERSONAL RELEVANCE</td>
<td>Never</td>
</tr>
<tr>
<td>31. In this class, students learn about the world outside of school.</td>
<td>1</td>
</tr>
<tr>
<td>32. In this class, they learn how math can be part of real life,</td>
<td>1</td>
</tr>
<tr>
<td>33. What they learn, they can link to their previous knowledge.</td>
<td>1</td>
</tr>
<tr>
<td>34. They get better understanding of the world outside of school.</td>
<td>1</td>
</tr>
<tr>
<td>35. They learn interesting things about the life outside of school.</td>
<td>1</td>
</tr>
<tr>
<td>VIII). STUDENT NEGOTIATION</td>
<td>Never</td>
</tr>
<tr>
<td>36. Students get the chance to talk to other students.</td>
<td>1</td>
</tr>
<tr>
<td>37. They talk to other students about how to solve problems.</td>
<td>1</td>
</tr>
<tr>
<td>38. They have the opportunity to explain their ideas to one another.</td>
<td>1</td>
</tr>
<tr>
<td>39. They ask each other to explain their ideas to one another.</td>
<td>1</td>
</tr>
<tr>
<td>40. They listen carefully to each other’ ideas.</td>
<td>1</td>
</tr>
</tbody>
</table>

**************************Thank You for your Support & Participation!**************************
Appendix E: Interview Questions for Students

Interviewee IDNo:……………………Status:……………………Gender: Male/Female(tick on one)
Location/Place:……………………Day/Date:……………………Time:…………to…………(Minutes

Topic: Investigating Perceptions of Mathematics Classroom Environment in Bhutanese Secondary Schools from the Perspective of New Mathematics Curriculum

Introduction
Hello, I am happy to meet you, all. Welcome to talk with me and discuss about my study. I really appreciate your willingness to spend some time with me. I am Rinchen, and I am currently studying as a full-time external PhD student at Queensland University of Technology, Australia. My study is about “Perceptions of Classroom Learning Environment in Bhutanese Lower Secondary Schools from the Perspective of New Mathematics Curriculum.” I am trying to collect views and opinions from different people like you through discussion and talk. If you are not clear with my questions you can always ask me. I will be happy to explain to the best of my knowledge and capability.

Questions
1. How do you find learning mathematics? ‘Many students like you feel that mathematics is very difficult.’ How far do you agree with such statement?
2. Tell me about the support and care you get from your teachers or friends in learning mathematics.
3. What is your personal concern about tasks you do in your mathematics class?
4. How do you all cooperate in learning mathematics?
5. How often do you ask questions to your teacher and friends about learning mathematics?
6. What do you think about mathematical games you play in your classes?
7. What is your feeling about the amount of help and encouragement you get from your teacher in learning mathematics? Is he or she able to give equal attention to all of you?
8. What are the things that could help you in learning mathematics? What are the things that support and motivate your mathematics learning?

………………

Conclusion
Thank you very much for your time and responses. I am extremely delighted by your cooperation, and your wonderful answers.
Appendix F: Teacher Interview Questions

Interviewee ID.No:……………Interviewee Status:……………Gender(Tick one only):Male/Female
Location/Place:……………Day/Date:………………Time:………………to………………(Minutes)

Topic: Investigating Perceptions of Classroom Learning Environment in Bhutanese Secondary Schools from the Perspective of New Math Curriculum

Introduction

Hello Sir……..I am happy to meet you. I really appreciate your willingness to spend some time with me. I am Rinchen, and I am currently, studying at QUT, Australia. My research topic is “Perceptions of Classroom Learning Environments in Bhutanese Lower Secondary Schools from the perspective of the New Mathematics Curriculum.” I am trying to collect views and opinions from different people like you through discussion and talk. If you are not clear with some of my questions or points you can always ask, as we proceed along. I will be happy to explain to the best of my knowledge.

Interview Questions

1. What is the main difference between two curricula-old and new mathematics?

2. What is your personal feeling about the support you give to your students in learning mathematics?

3. Could you share about the satisfaction you get about the group work and pair works your students do in mathematics class?

4. What is your feeling about the way they cooperate and support each other in learning mathematics?

5. How are you able to treat your students equally in the process of teaching mathematics?

6. What is your view on task orientation of your students?

7. What are some of the contributing factors that might affect your classroom environment, which might in turn support or hinder effective implementation of new curriculum?

8. “Substantial consideration be given to the re-training and ongoing coaching of teachers, and that a long term commitment to a system of support be maintained.” What do you have to say on this?

9. “Sufficient materials be supplied to all classrooms and students be given ready access to them.” What is the reality of this recommendation in your classrooms?

10. “The new mathematics curriculum requires a change in the classroom environment to include more pair works, and group work and an increased emphasis on communication” (Teacher’s guide for Understanding Mathematics- Class VIII, p.xx). What is your view on this statement?

Conclusion

Thank you very much for your time and responses. I am extremely delighted by your cooperation, and your wonderful answers.