A STUDY OF THE EMOTIONAL CLIMATE OF A SCIENCE EDUCATION CLASS FOR PRE-SERVICE TEACHERS IN BHUTAN

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Emotional Climate, Collective Effervescence, Emotional Entrainment, Emotional Energy, Interaction Rituals, Mutual Focus, Pre-service Teachers, Teacher Emotions, Science Teacher Education.
Abstract

Teaching is an emotional activity, yet the role of emotion in teaching has received little attention. This is especially the case with pre-service teachers. In this case study, I examined the emotional climate of 28 (18 male and 10 female) Bachelor of Education pre-service secondary science teachers and their tutor’s science education classroom at the Case College of Education, Royal University of Bhutan. Sociological perspectives of human emotions and Interaction Ritual Theory were used as lenses to provide a detailed analysis of the pre-service teachers’ emotional arousal, tutor-student and student-student interactions, and emotional climate of the classroom. It was a multifaceted study involving video and audio recordings of the teaching episodes supported by interviews, field notes, and cogenerative dialogues.

The findings of this study highlighted that the activities and relationships between the tutor (lecturer) and students (pre-service teachers) matter to student perceptions of emotional climate. For instance, positive emotional climate was identified in activities involving students’ presentations using video clips and models, group activity, coteaching, humorous moments, and interactive whole class discussions. Successful interactions were characterised by mutual focus of attention, shared emotion, and positive emotional energy. The structure of successful class interactions can be replicated by other science educators who wish to produce positive emotional climate in their classes at both high school and college levels. Negative emotional climate was identified when the tutor ignored students’ responses, during formal lectures, when the tutor was uncertain of subject knowledge, interruptions from students, and when the tutor did not show up to the class. Such classes were characterised by the tutor or students in terms of frustration or disappointment.
Cogenerative dialogues helped to ascertain what worked and should be strengthened, and to identify intervention strategies that improved classroom practices. The other innovative feature of this study was the use of a moment-by-moment self-reporting technology called keypads or clickers to measure student perceptions of the emotional climate of their science class. The emotional climate was positively valenced when the classroom events were characterised by interactions between the tutor and students that were fuelled by humour and collective effervescence. Conversely, the class emotional climate was negatively valenced when the tutor dominated the session and the interactions were univocal.

This study recommends several enabling conditions (e.g., individual engagement, frequency of interaction and informality of interaction, cogenerative dialogue, and presence of resources) to sustain mutual focus of attention and shared emotion during classroom interactions.
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<tbody>
<tr>
<td>B.Ed</td>
<td>Bachelor of Education</td>
</tr>
<tr>
<td>CAPSD</td>
<td>Curriculum and Professional Support Division</td>
</tr>
<tr>
<td>CCE</td>
<td>Case College of Education</td>
</tr>
<tr>
<td>CTDD</td>
<td>Curriculum and Textbook Development Division</td>
</tr>
<tr>
<td>EC</td>
<td>Emotional Climate</td>
</tr>
<tr>
<td>EE</td>
<td>Emotional Energy</td>
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<tr>
<td>ESRC</td>
<td>Education Sector Review Commission</td>
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<tr>
<td>GNH</td>
<td>Gross National Happiness</td>
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<tr>
<td>IRT</td>
<td>Interaction Ritual Theory</td>
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<tr>
<td>MOE</td>
<td>Ministry of Education</td>
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<tr>
<td>MOF</td>
<td>Ministry of Finance</td>
</tr>
<tr>
<td>OCC</td>
<td>Office of the Census Commissioner</td>
</tr>
<tr>
<td>RGOB</td>
<td>Royal Government of Bhutan</td>
</tr>
<tr>
<td>RUB</td>
<td>Royal University of Bhutan</td>
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</table>
Statement of Original Authorship

The work 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: QUT Verified Signature

Date: 7.6.2014
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This study will have served its purpose if it succeeds in fostering a better understanding of emotions in the teacher education system in Bhutan and the impact of emotions on teaching and learning of science by Bhutanese teachers and students.

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Publications and Conference Papers

Paper Presentations


Chapter 1: SITUATING THE STUDY

I became a teacher by chance. I never thought that I would become a teacher as the mere idea of having to face 40 or so pairs of eyes staring at me and watching every move I made scared me. I had ups and downs during my early years of teaching. Having to teach 30 hours a week including Saturdays besides administrative responsibilities was tiresome. Correction of home assignments and examination papers was daunting. I also had good times when my classes went well and students enjoyed my teaching. I was saddened when I heard my colleagues considered students as empty vessels that needed to be filled up. Constraints of resources further exacerbated the plight of students when classes were conducted in the open air, along with inadequate library and laboratory facilities. What pained me most was that some students had to walk to school in the early hours of morning and get back home only to have dinner and sleep before repeating the cycle. Teachers were authority figures and students were scared in their presence. They caned students for failing to submit homework or for not having memorised notes. There were even instances when students skipped classes to avoid beatings from the teachers. Less frequently, students were also whipped openly for their misconduct.

Even though the university is a different context from schools, teaching at university creates similar emotional experiences for both students and teachers. The lecturers are overburdened with heavy teaching loads and the evaluation of exam papers and research projects. This problem is confounded by limited university budgets that do not enable the hiring of research assistants or markers as practised in the West.

This study enabled me to unravel the emotional journey of 28 pre-service secondary science teachers in a science classroom at a Case College in Bhutan. The
findings suggest that a tutor can make science learning a positive emotional experience for students that encourages them to attend science classes. It is hoped that these 28 pre-service science teachers will be able to make a difference in the lives of science students and science teacher colleagues in the schools in the near future just as their university tutor made a difference for them.

1.1. BACKGROUND TO THE STUDY

This study of the emotional climate (EC) of a university science education class for pre-service teachers is situated in the nation of Bhutan. Bhutan is a land-locked country in the Great Himalayas, between India and the Tibetan region of China, occupying an area of about 38,394 square kilometres. Bhutan has a small population of 720,679 (Royal Government of Bhutan [RGOB], 2012); it has a literacy rate of 60%, and an unemployment rate of 3.1% (Office of the Census Commissioner [OCC], 2005). Importantly, Bhutan is identified globally for its policy of Gross National Happiness (GNH). Education, as one of the nine domains of GNH, is vital to the accomplishment of this policy. The GNH policy is pertinent to this study because it investigates the EC of a class with pre-service secondary science teachers in a teacher education program.

Modern education came to Bhutan only in the early 1960s. Prior to the advent of modern education, most Bhutanese children underwent monastic education in the Buddhist monasteries. The transmission of knowledge, skills, and values were mostly done orally. Bhutan began her socio-economic developmental activities in a more organised manner only with the launch of the first Five Year Plan in 1961. With the launching of this Plan any developmental activities in Bhutan were properly planned and mobilised to different sectors and regions (RGOB, 1999). Since then, any approach to development such as the building of infrastructure, and motorable roads were considered as modern advances for the nation.
Hence, the education system offered from 1961 onwards has been branded as modern education within the purview of overall national development. Science and other disciplines also appear to have been introduced in the schools with English as the medium of instruction during the reign of the third King of Bhutan (1952-1972). Cognisant of the importance of English as an international language, the King believed that modern education will not only help to build networks with the rest of the world, but also will develop human resources for the socio-economic development of the country.

There are several reasons this study is important for Bhutan’s emerging emphasis on science education. Before identifying these, a brief background to science education in Bhutan is provided to contextualise this study. Science education came very late to Bhutan. Teachers and curriculum were borrowed from India (Republic of India). However, these teachers were young and inexperienced. Even the experienced ones were teaching for the first time in this new environment and the most preferred mode of teaching science was direct teaching with heavy reference to a textbook.

In 1986, the primary science curriculum was replaced by a new curriculum known as New Approach to Primary Education to make science curriculum in grades 4–6 more investigative as opposed to the traditional methods of memorising facts and figures that dominated the earlier curriculum (Fahmi, 2008). An approach that favours investigation or inquiry methods forms a stronger basis for the application of scientific skills in later life (Johnson, Childs, Ramachandran, & Tenzin, 2008).

To maintain progression from grades 4–6 science, an integrated science for grades 7–8 was introduced between 1999 and 2000, respectively in lieu of three sciences (i.e., Physics, Chemistry, and Biology). However, the science curriculum for grades 9–12 and beyond remained that of a single science curriculum borrowed from India. The sciences
for grades 6–12 and beyond are taught in English whereas the sciences for grades pre-
primary to grade 3 are taught in the national language Dzongkha.

Science education in Bhutan continues to face challenges, which includes cultural
inappropriateness, lack of qualified science teachers, resource constraints, science being
taught in English (i.e., a foreign language), and the lack of progression in science
content across different grades. Fahmi (2008) reported the major factor that affected the
quality of science programs in schools and beyond is the discontinuity in the pedagogy
and science curriculum from primary science to higher secondary science. For instance,
in lower grades, the emphasis was more on activity-based learning but as they transit to
grade 9 and above the mode is more of teacher-led (Childs, Tenzin, Johnson, &
Ramachandran, 2012). Moreover, as science in pre-primary to grade 3 was taught in
Dzongkha and these students found it difficult as they transited to grade 4 and above
where the science is taught in English.

Students even at the tertiary level are not confident to communicate in English.
Since the students feel uncomfortable to raise questions or present their views openly in
class they often mumble while speaking or seek solace in the group by giving choral
answers (Rinchen, 2009) though choral answers are discouraged at the schools or
colleges of Bhutan. Studies confirm that innovative curricula and well qualified teachers
will have little impact on learning if students are not meaningfully engaged in the class
(Cothran & Ennis, 2000).

Although the education system has improved both in terms of quality and
infrastructure, there is a need for a scientifically-educated populace to steer the country
forward and to plan for the future. As formal science education matures in Bhutan, a
shift in orientation from theoretical to practical or applied matters can be expected.
Students’ involvement in laboratory investigations in school classes aims to enable
students to attain the skills of handling equipment and solving problems in a practical context (Curriculum and Textbook Development Division [CTDD], 1992).

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. Students dare not to question or challenge teachers, even if they are wrong, as talking back to the teacher is culturally inappropriate. Unsurprisingly, in this context classroom interactions become univocal.

Due to cultural inhibitions, many students tend to be very self-effacing. Students are shy in nature, especially girls, and rarely participate in discussions. Even at the tertiary level the trend continues where students seldom participate in classroom discussions. For instance, Rinchen’s study (2009) of pre-service teachers’ reflections reported:

The [pre-service teachers] were … meek and shy. They seldom took part in the class discussion unless forced to or asked by the tutor to speak. The students appeared very tense in the classroom and in order to avoid questions from the tutor they keep their heads down. It was also noticed that the few students who wished to partake in the discussion were ridiculed by others. (p.13)

1.2 RESEARCH CONTEXT

The previous section outlined some of the national issues facing science education in Bhutan and the different cultural context in which science is taught. In the next section, the specific context of the university science class in which this study was situated is detailed.
1.2.1 Science Education in the Case College of Education, Royal University of Bhutan.

The Bachelor of Education (B.Ed) secondary science program was launched in the Case College of Education (CCE), one of the two colleges of education at the Royal University of Bhutan (RUB) in 1983, in pursuit of developing our own human resources in science teaching. Before this, most of the science teachers in the schools were expatriates with a handful of Bhutanese who graduated from abroad. This was also a time when the education system in the country was undergoing transformation. The key to the changes that ensued would be the training of our own science teachers in Bhutan. In the initial phase, the B.Ed programme received support from the School of Education, London University until 1993. To ensure the quality of the program, the B.Ed syllabus was designed jointly by experts from London, India, and counterparts from Bhutan. In order to maintain standards, the B.Ed secondary science test papers were sent to London for moderation and feedback. The officials from London University visited the college to moderate student answer scripts and to award marks (Davis, 1982). The 1993 cohort was the last batch to receive the seal of London University on their certificate. From 1994 the B.Ed secondary program began to function independently.

The science course in the B.Ed program was designed to prepare teachers who would be able to teach science (Physics, Chemistry, & Biology) effectively in secondary schools and integrated science in lower secondary schools. The course aims to help pre-service teachers to understand the use of scientific knowledge, values and skills in their daily lives. This would in turn contribute positively to the scientific development of the nation.
The B.Ed is a four-year program in the Case College of Education and pre-service teachers enrolled in the B.Ed science program are required to specialise in two science subjects with the following combinations (Chemistry–Physics, Chemistry–Biology, & Physics–Mathematics). In this thesis pre-service teachers are referred to as students and pre-service teachers alternatively and their lecturer as a tutor.

The class which participated in my study belonged to the Physics–Mathematics strand. In order to graduate from the college with a B.Ed degree, these pre-service teachers (students) need to attend and complete 40 compulsory modules. The content of each module provides a balanced structure of concepts with an adequate emphasis on practical experiments, investigations, and research projects. Each module consists of a set of learning opportunities, organised around a well-defined topic, which contains: Specific objectives, Learning outcomes, Skills to be developed, Teaching-Learning activities, and Evaluation that uses a criterion-referenced approach (Samtse College of Education [SCE], 2009). The content selected aimed to meet the following requirements:

i. Importance in the relationship to the national policy.
ii. Importance in the relationship to everyday life in Bhutan.
iii. Importance in the relationship to present and possible future school science programs.
iv. Suitability for developing an understanding beyond school level. (SCE, 2009)

It is reflected in the B.Ed syllabus handbook that the goal of scientific literacy for all can be achieved through a balanced curriculum in which science is taught with broad aims. The main aims and objectives of the science curriculum are to ensure that pre-service teachers gain some knowledge of the world, the vocabulary and genres of science and scientific reports, the ability to observe objectively, solve problems and
think scientifically, and be aware of the implications and effects of science on society (SCE, 2009).

In a span of four years these students are required to take 10 modules of Mathematics, 10 modules of Physics (see Appendix A) while the remaining 20 modules include personal and professional modules. Of the 10 modules in Physics, eight of the modules are content based (i.e., focusing on Physics concepts) and the remaining two modules are education modules (i.e., Physics Education I and Physics Education II). My study is focussed on Physics Education II. This module aims to familiarise pre-service teachers with the national science policy, acquainting them with the Physics syllabus currently taught in middle schools and high schools and how they are assessed. The other features include the need to teach Physics in schools and the importance of Physics in our daily lives. The students are also given firsthand experience with school Physics textbooks and school level practicals such as running experiments. Information on first aid and safety measures is also incorporated should there be any accident in the science laboratory. Skills on improvisation of apparatus using locally available resources are also taught, in case students are placed in remote schools where the laboratory facilities are limited (SCE, 2009).

The personal modules are aimed at developing Language and Information Communication Technology (ICT) competencies that are vital tools for teachers in the classroom. The professional modules are designed to facilitate the growth of professional knowledge and skills in the areas of Bhutanese Education System, Curriculum Development Process, Understanding the Learner, Pedagogy, and Research Methods.

The way science is currently taught in Bhutan is based on a mechanistic view; that is, science is abstract and far removed from everyday life (Hayward & Colman,
In 2009 a conference on Gross National Happiness (GNH) was held in Paro, Bhutan. The participants in the workshop comprised of heads of schools and institutions in the country and scholars from both Bhutan and international organisations. The purpose of the conference was to discuss the need and feasibility of introducing GNH in the schools and institutions in the country. The participants in the workshop recommended a holistic, integrative approach more consistent with GNH principles such as learning based on observing and learning from nature. A group of participants reported that “it isn’t the people who are scientifically illiterate who are wrecking the earth but it is the scientifically literate people who are ruining the earth” (Hayward & Colman, 2010, p. 23). This suggests that there is a need to challenge the way science is currently taught in Bhutan. Instead of following the existing curriculum and textbooks, a new approach that values indigenous knowledge that also draws on wisdom of maintaining harmony with nature should be introduced (Hayward & Colman, 2010). Pre-service science education programs should address this challenge.

1.3 DILEMMAS WITH SCIENCE TEACHERS

More than 42% of the Bhutan’s public sector workforce are teachers including lecturers from the RUB (RGOB, 2012). However, there is still a shortage of science teachers in both schools and tertiary institutions in Bhutan. It is imperative that we attract and retain science teachers through the provision of incentives. In 1999, an incentive of a 30% rise in all the teachers’ salary was instituted (Ministry of Finance [MOF], 1999) with an additional 15% for Physics and Mathematics teachers in 2009 (MOF, 2009). Though incentives have been put in place, retention of teachers, especially good ones, remains problematic. The Ministry of Education also touted banning teachers from leaving the teaching profession (Wangchuk, 2010). The attrition rate of teachers, especially science teachers, has become a global concern. For example,
as per the report of The National Commission on Teaching and America’s Future (2002), every year, one out of five science teachers choose to leave the teaching profession in the US. In Australia too, a considerable number of science teachers leave the profession every year (McKenzie, Kos, Walker, & Hong, 2007).

The story is not different in Bhutan. The Ministry of Education (2010) and the Royal University of Bhutan (2011) note generally (i.e., without statistical evidence) a good number of teachers have left teaching for managerial posts or have transferred to other departments. Unfortunately, many of them are science teachers. Despite the Ministry’s effort to address attrition by recruiting fresh college graduates as temporary teachers through a project called Light Drukyul Project, it remains one of the most pertinent issues in the education sector since 2011. As of 2013, the Ministry of Education acknowledged a teacher deficit of about 1692 teachers (Zangmo, 2013). From the outset of 2011, some students of two higher secondary schools in Bhutan have left their present schools for other schools in the country as their present schools did not have a science teacher (Namgyel, 2011). A study by Dorji (2007) in Bhutan reported that only three teachers from a total of 51 teachers with a teaching experience between 3–35 years expressed being positive and happy as a teacher. The remaining cohort expressed frustration, dissatisfaction and low morale and motivation. The study also revealed that the younger generation of teachers with 7–10 years of teaching experience seemed more ambitious and dissatisfied than their senior colleagues. For most of them teaching was not their first choice. The reasons cited by these teachers for their frustration and dissatisfaction included extra responsibility that they have to shoulder such as library work, store keeping, and coordinating co-curricular activities. Lack of training opportunities, unattractive salary packages, and remote postings were also cited as reasons for their low morale and frustration. Many contend that their salary could not
support a decent living, and training opportunities were given to undeserving candidates. The teachers posted in remote places were deprived of basic amenities like roads and electricity. Dorji (2007) argued that even if one teacher is dissatisfied and demotivated it makes an impact because the single individual would be teaching about a hundred students every day. If this issue is left unresolved, it could affect the quality of education in general and science education in particular.

Prior to 2009, the policy of GNH was on a macro level of good governance, socio-economic development, environment, international relations, and job classification. It was only in 2010 after the GNH workshop for educators in late December, 2009, GNH was introduced in the schools and institutions in Bhutan. The need to introduce GNH in schools and institutions was echoed in the words of his Excellency the Prime Minister of Bhutan while addressing the participants during the workshop, 26th December, 2009:

Infusing GNH into the education system is not adding a new subject but enriching, and improving the process of education. It has to do with creating a content and approach that infuse a GNH consciousness into everything that is learned and taught. This will make the curriculum and learning more enjoyable, more pleasurable, and more relevant.

Often there is no clarity on why we teach things, and so, learning is inevitably boring. Infusing GNH understanding creates a purpose and goal for teaching and learning for both teachers and students that makes study less burdensome and more enjoyable.

Following the GNH workshop the Ministry of Education identified five key elements to infuse GNH principles and values in the schools and institutions. The five elements comprised; meditation (to improve concentration), integrate GNH into subjects, broaden learning environment (not to confine learning into four walls of a classroom), media
literacy (to be more open and critical in their decision), and assessment (be accountable and responsible for their learning and actions).

Since then no study has been conducted to see to what extent the schools and institutions incorporated the five elements of GNH into their system. From my observations, most schools and institutions have taken initiatives of infusing the five elements in their context, but I am sceptical about the seriousness of the degree of implementation owing to numerous factors. For instance, most schools and institutions conduct meditation for students simply for the sake of doing it. So similarly, the other elements met with the same fate owing to lack of time, resources, and expertise.

Therefore, Bhutan’s macro-social policy of GNH is only possible if it reflects happiness that exists between interacting participants during micro-social processes, like exchanges in classrooms while infusing the elements of GNH.

1.4 INTERACTIONS AND EMOTIONAL CLIMATE

Classroom interactions generate emotions in students and teachers alike. Teachers and students are in continuous dialogue during a school day. Interactions can be verbal (i.e., while lecturing, demonstrating, discussing, and reinforcing) and non-verbal (such as during expressive gestures and physiological changes) evident in students and the teacher.

My study employed a sociological perspective of emotions based on Collins’s (2004) Interaction Ritual Theory (IRT) and Turner’s 17 principles of human emotion (Turner, 2007). Every individual enters an interaction with certain expectations which influence their emotional state. If their expectations are met, the individual will experience positive emotions. The converse is true; if their expectations are not realised, the individual will experience negative emotions.
Interactions can lead to arguments and feedback from colleagues which affect the emotions of an individual. These emotions influence the general levels of *emotional energy* (EE) of the individuals involved and ultimately the *emotional climate* (EC) of the collective group, such as a classroom, within which the interactions are occurring. According to Collins (2004), emotional energy is generated when there is synchrony in body movements, facial expressions, and vocalisations of actors involved in the interactions. For instance, a class that responds to a group role-play with laughter and applause displays positive emotional energy (Tobin, Ritchie, Oakley, Mergard, & Hudson, 2013).

From a sociological perspective, EC is produced when members of a group or class experience collective states of joy, sadness, sense of belongingness, rather than at the individual level (Bellocchi, Ritchie, Tobin, Sandhu, & Sandhu, 2013; Tobin et al., 2013). Bellocchi et al. (2013) report that EC has been conceived in different ways in various contexts including elementary and early childhood education (e.g., Evans, Harvey, Buckley, & Yan, 2009), and, more recently, school science education (Tobin et al., 2013), and university science-education classes.

Evans et al. (2009) contend that EC encompasses five elements. *Emotional relationship* refers to the intensity of warmth and pleasant attitude between students and teachers. *Emotional awareness* pertains to teachers being able to recognise and handle their own emotional reactions to varying situations. *Emotional coaching* relates to teachers helping students to monitor or regulate their emotions. *Emotional intrapersonal beliefs* describe an array of events and ideas which influence students’ emotions. *Emotional interpersonal guidelines* refer to emotional boundaries and standards within the group.
A recent study in an Australian school found that the class EC varied noticeably across a classroom lesson (Tobin et al., 2013). In the study, the classroom EC was rated by the teacher and researchers independently reviewing a video recorded lesson. Unlike Tobin et al.’s study, my study investigated in the moment variability in EC from the perspective of pre-service teachers and their tutor during instruction. That is, the pre-service teachers rated the class EC at regular intervals as classroom instruction unfolded.

1.5 OVERVIEW OF RESEARCH DESIGN

This research explored the EC of a science education class in the B.Ed pre-service teachers’ programme at RUB over five months by adopting ethnographic procedures (Spradley, 1979). Data were collected through a multi-method approach that drew on ratings of class EC, video recordings of lessons, cogenerative dialogue with selected students and their tutor to generate plans for future actions and insights into the EC of their classrooms, semi-structured interviews of all students, stimulated recall interviews with the tutor, and the author maintaining a research diary.

The data were analysed by employing various tools. The students’ perceptions of class EC were obtained from analysing segments of the lesson where the EC changed, from peaks to troughs or vice versa. Salient events (e.g., events that generated high EC and low EC) from the video recordings were analysed at the micro level through prosody for speech, and eMotion software and Ekman’s Facial Action Coding System (FACS) for facial expressions of emotion. An event refers to an incident that begins with a breach of some kind followed by a series of further breaches that leads to transformation of structures, strategies, resources, and balance of power in any organisation (see Sewell, 2005).
The relevant verbal conduct from the video segments were analysed using an approach that was similar to conversation analysis. The proceedings from cogenenerative dialogue (cogen), semi-structured interviews and stimulated recall interviews were transcribed and assessed for themes that were relevant to the research questions and themes that emerged from other sources. The diary accounts helped me to organise the data and to supplement salient features of video data and interviews. Cogen refers to a dialogue between selected students and teachers involved in the class to share perspectives and reflect on what happened in the class and what needs to be done to improve teaching and learning in the subsequent classes (Tobin & Roth, 2006) [see Chapter 4 for details].

Turner (2007) proposed that social reality is revealed through three levels including micro, meso, and macro. This study examined emotions from micro and meso perspectives, focusing on how interactions are affected by emotions and the classroom environment, and how these, in turn, shape the EC of the classroom. At the micro level, emotional arousal occurs through interactions and encounters between individuals. Micro level forces such as expectation states and sanctions drive the interactions of the individuals involved in an encounter. The meso level refers to interactions that occur within a classroom or family. The interactions that occur within meso level structures help shape the culture of that structure. The overarching macro level of social reality is composed of structures of politics, economy, religion, and education system. Macro level forces can influence meso-level structures and micro-level encounters. GNH is an example of a macro-social force influencing teacher education in Bhutan.

The specific methods and analytical procedures used in the study are detailed in Chapter 4.
1.6 RESEARCH PROBLEM

The philosophy of Gross National Happiness (GNH) intends to uplift the emotions of its citizens by providing free education including scholarships to universities outside Bhutan, free medical facilities, preservation of the environment, and the provision of good governance. One of the nine domains of the GNH policy is to produce quality teachers to improve the quality of education in Bhutan. The onus of producing quality teachers rests with the colleges of education in Bhutan. This study was conceptualised to begin the process of narrowing the gap between an ideology of GNH and the prevalence of negative emotions by producing quality teachers who have experienced positive emotional activities in university. Studying classroom contexts and tutor-student interactions provide opportunities to become more aware of pre-service teachers’ emotions.

In the recent past, there was a public concern about the quality of education in Bhutan (Center for Educational Research and Development, 2007). The quality of education is seen as the primary vehicle to achieve the desire of the Royal Government of Bhutan to produce experts in the field of science and technology and provide gainful employment to all its citizens (Office of the Cabinet Ministers, 2006). Studying pre-service teachers and conditions of teaching can give us valuable insights as to how to reform teaching more widely.

1.6.1 Research Question

The overarching question for this study was: What is the nature of pre-service secondary science teachers’ classroom emotional climate at the Case College of Education, Royal University of Bhutan?

In exploring this question, the following specific questions were used to guide the study:
1. What affects the emotional climate in a science classroom for pre-service teachers?

2. How do pre-service teachers respond to classroom interventions to improve the emotional climate of a science class?

1.7 SIGNIFICANCE OF THE RESEARCH

Emotions are a vital part of teachers’ lives (Mayer, Salovey, & Caruso, 2000) as they interact with students on a daily basis. The success of classroom interactions depends on and affects the type of emotions they experience.

A socially and emotionally competent teacher is one who creates a positive EC in the class by developing strong bonds with students, designing lessons that build on students’ strengths and abilities, establishing and implementing behavioural strategies in ways that motivate students, coaching students to manage conflict situations and through exemplary leadership (Eccles & Roeser, 1999). Therefore, knowledge of teachers’ emotions and the classroom EC that they generate is essential for understanding teachers and teaching.

There are very few studies on the EC of science education classes in a university setting worldwide. This research will be a pioneering effort in Bhutan in general and the Royal University of Bhutan in particular. The results obtained from this study will help teachers and researchers to understand the EC in a science classroom, as it changes every moment. Based on these results, informed decisions can be made on curriculum changes, improvements in teaching methods and facilities, and assessment procedures. Some appropriate intervention strategies may be proposed to improve the EC of science classes. This study may be useful for the overall improvement of teaching science in the country with far reaching implications for producing a skilled scientifically and technologically literate workforce in the country.
This study occupies a unique niche in the field because:

i. It aimed to study the EC of a class of secondary pre-service science teachers.
ii. Innovative data collection software such as Turning Point™ and Keypads were introduced in the Bhutan setting.
iii. New tools such as PRAAT, eMotion, and Ekman’s facial expression analysis were utilised in this study to analyse the data.
iv. Cogen helped to transform classroom teaching practices and ultimately classroom EC.

1.8 OVERVIEW OF THE STUDY

This thesis is organised into eight chapters. This chapter (Chapter 1) has outlined the background and significance of the project. The conceptual framework for the study is described in Chapter 2 by outlining the range of theoretical perspectives drawn on in this study. A literature review of the existing empirical literature relating to EC in science teaching and learning is presented in Chapter 3. Chapter 4 presents the design of the study – the methodology, participants, data collection methods, procedures, analysis tools, and ethical considerations. The findings of the study are reported in two parts. Firstly, Chapter 5 discusses the events experienced by the students and how these events affected the EC of the science class; and secondly, Chapter 6 discusses how students responded to intervention strategies adopted in the class following cogens. Chapter 7 draws the research together by discussing the events that impacted the EC of the pre-service teachers’ science class. Finally, Chapter 8 concludes the thesis by summarising the results, discussing the implications for teaching and research as well as limitations of the study and areas for further research.
Chapter 2: THEORETICAL FRAMEWORK

2.1 INTRODUCTION

This thesis employed sociological theories advocated by Turner (2007) and Collins (2004) to understand the production of emotional climate (EC) and emotions in a pre-service teacher science class. Expectation states and sanctions are two elements of Turner’s theory that were used in this thesis to understand the emotional arousal experienced by the teacher and students.

This chapter introduces the theoretical framework in Section 2.1 and briefly explains emotion in Section 2.2. Emotional arousal is described in Section 2.3 and social structure is outlined in Section 2.4. Section 2.5 details how Interaction Ritual Theory was employed to position the analysis of EC in relation to interactions in the classroom. Finally, the chapter concludes with the summary of the theoretical framework in Section 2.6.

2.2 DEFINING EMOTIONS

Humans are emotional beings. They experience love, hatred, joy, shame, guilt, depression, and revenge as well as many other emotions. Emotions can be powerful tools that unite and tear apart individuals and societies. We use emotions to build social bonds (Collins, 2004), and to create and sustain commitments to social structures. In individuals, emotions are aroused when steps are taken to fulfill one’s biological and transactional needs (Turner, 2007). Often, emotions impact on culture, values, ideologies, symbols, media, beliefs, and societal norms.
Though the study of emotions has a long history, there is a dearth of research on the role played by emotions in learning to teach, how teachers’ emotional experiences affect their teaching practices, and how the socio-cultural context of teaching interacts with teachers’ emotions (Schutz & Zembylas, 2009). Cognisant of the fact that there is no definition of emotion acceptable to all scholars in the field, different theorists have given varying definitions of emotion. Although researchers may not agree on a definition of emotion, the general sense shared by all definitions is that emotional responses in humans include three interrelated sets of processes:

i. neurophysiologic and biochemical process (e.g., rate of heart beat, skin response, and hormonal levels)
ii. motor and behavioural-expressive processes (e.g., facial expressions, changes in posture, and tone of voice)
iii. cognitive-experiential system (e.g., subjective awareness and labeling feelings). (Brenner & Salovey, 1997; Taylor, Bagby, & Parker, 1997)

From a cognitive perspective emotions are defined as conscious feelings about self and objects in the environment and as words and labels that humans give to particular physiological states of arousal from a cultural perspective (Turner, 2007).

A definition of emotion by Burkitt (1997) signals both complexity and relationality:

…emotions are multi-dimensional and cannot be reduced to biology, relations, or discourse alone, but belong to all these dimensions as they are constituted in ongoing relational practices. As such, the objects of our study in the sociology of emotions cannot be understood as ‘things’ but are complexes composed of different dimensions of embodied, interdependent human existence. (p. 42)

Although research interest on emotions has grown in recent times, understanding of the term emotion is still obscure (Turner, 2009). People usually associate emotions with their state of mood and feelings which are influenced by their epistemological perspectives (Thoits, 1989). This study employs a sociological perspective of emotions
that uses four elements of emotions identified by Thoits (1990) to structure an understanding of the term. Thoits’s four elements of emotions are: *situational cues* (factors which prompt the arousal of different varying intensities of emotions); *emotional labels* refers to varying words used to describe emotions such as happiness and sadness, which can vary across cultures (Smith & Schneider, 2009); *expressive gestures* (including facial expressions and body gestures); and *physiological changes* (when an individual experiences emotions, physiological responses such as an increased heart beat are evident). The above four elements of emotion are related and mutually influence each other (Turner, 2007). For example, any particular emotion (e.g., teacher getting angry) is influenced by a situation (e.g., student’s misbehaviour) and may be accompanied by expressive gestures (e.g., scowl on teacher’s face with fist thumping table) and physiological changes (e.g., reddening of face of a teacher). The use of Thoits’ four elements to explain emotions provides a lens through which emotions can be understood.

In addition to the four general elements outlined by Thoits (1990), in this thesis emotions are categorised into four primary emotions; namely, satisfaction-happiness, aversion-fear, assertion-anger, and disappointment-sadness (Turner, 2007). Satisfaction-happiness is classified as a positive emotion whereas, the other three are negative. In other words, the arousal of emotion is valenced; happiness is valenced positively with the other three primary emotions valenced negatively (Baumeister, Bratslausky, Finkenauer, & Vohs, 2001). Turner (2007) details variations of primary emotions in the form of first-order elaborations of these primary emotions. For example, mixing of two primary emotions, such as satisfaction-happiness and aversion-fear, produces relief and gratitude. Second-order elaborations of primary emotions are also possible (e.g., mixes
of three primary emotions, such as anger, fear and sadness producing guilt, shame and alienation).

Humans’ primary emotions may be aroused at varying levels of intensity: low, medium and high intensity states. Emotional intensity refers to how strongly an emotion is experienced. For instance, the emotion of contentment can be considered a low intensity variant of happiness, whereas joy is a high intensity variant of happiness (Turner, 2007). Table 2.1 summarises the varying levels of intensity for the primary emotions.

Table 2.1

Variants of Primary Emotions

<table>
<thead>
<tr>
<th>Emotions</th>
<th>Low intensity variants</th>
<th>Moderate intensity variants</th>
<th>High intensity variants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction-Happiness</td>
<td>Content</td>
<td>Cheerful</td>
<td>Joy</td>
</tr>
<tr>
<td></td>
<td>Sanguine</td>
<td>Friendly</td>
<td>Elation</td>
</tr>
<tr>
<td></td>
<td>Serenity</td>
<td>Enjoyment</td>
<td>Delight</td>
</tr>
<tr>
<td>Aversion-Fear</td>
<td>Hesitant</td>
<td>Scared</td>
<td>Terror</td>
</tr>
<tr>
<td></td>
<td>Reluctance</td>
<td>Anxiety</td>
<td>Horror</td>
</tr>
<tr>
<td></td>
<td>Shyness</td>
<td>Panic</td>
<td>High anxiety</td>
</tr>
<tr>
<td>Assertion-Anger</td>
<td>Annoyed</td>
<td>Displeased</td>
<td>Dislike</td>
</tr>
<tr>
<td></td>
<td>Agitated</td>
<td>Offended</td>
<td>Disgust</td>
</tr>
<tr>
<td></td>
<td>Irritated</td>
<td>Frustrated</td>
<td>Hatred</td>
</tr>
<tr>
<td>Disappointment-Sadness</td>
<td>Discouraged</td>
<td>Dismayed</td>
<td>Sorrow</td>
</tr>
<tr>
<td></td>
<td>Downcast</td>
<td>Disheartened</td>
<td>Heartsick</td>
</tr>
<tr>
<td></td>
<td>Dispirited</td>
<td>Resigned</td>
<td>Anguish</td>
</tr>
</tbody>
</table>

Adapted from Turner (2007)

2.3 EMOTIONAL AROUSAL

Human beings experience emotions on an ongoing basis; we sometimes enter a state of arousal, in which our bodies experience heightened physiological activity and extremes of emotion. States of arousal can be positive and negative in experience, for example in excitement or fear (Berger, 2011).
Turner’s (2007) 17 principles of emotions are summarised in Appendix B, and the principles significant to my research are outlined in the sections that follow. According to Turner (2007) two basic processes - expectations and sanctions - are responsible for the arousal of emotions in humans. This theory assumes that when individuals enter situations or encounters they do so with certain expectations. In the process of interactions these expectations may or may not be met. The outcome of these interactions may influence an individual’s experience of positive or negative emotion (i.e., emotional valence) and the intensity of the emotional arousal. Similarly, sanctions (feedback) from others can influence emotional arousal.

2.3.1 Expectation states

When an individual enters an interaction or a situation, different emotional valences are aroused when their expectations are fulfilled or not met. These expectations come from a variety of sources and revolve around the characteristics of self, others and situation. These expectations are related not only to the outcome of the interaction, but to outcomes related to the attainment of transactional needs such as the need to be included or trusted in the group. Upon fulfilment of transactional needs, positively valenced emotions such as elation or joy may be aroused. Conversely, negative emotions such as frustration and anger may be aroused if transactional needs are not realised (Turner, 2009). This relates to Turner’s third principle, that is, when expectations (for self, others or the situation) are not met, negatively valenced emotions will be aroused.

2.3.2 Sanctions

Sanction refers to feedback such as spoken words (emotive expression like good), gestures (thumbs up) and facial expressions (smile on the face) expressed between individuals in an interaction. The flow of interaction in encounters is a process of
mutual sanctioning. When individuals see others supporting their actions, they feel that they are being sanctioned positively and, as a result, they feel positive emotions. This relates to Turner’s fourth principle, that is, when individuals perceive that they have received positive sanctions from others, they will experience positive emotions and be more likely to give off positive sanctions to others. This mutual flow of positive sanctioning can increase synchronisation of talk and body language, and feelings of group solidarity. For instance, students enter a class with an expectation that the particular science lesson will be engaging and motivating. If this expectation is met, students will give positive sanction to their teacher and friends through smiles, applaud, and even by thanking the teacher. Conversely, lack of support from others can be perceived as a negative sanction. Negative sanctions typically arouse negative emotions (Turner, 2007).

2.4 SOCIAL STRUCTURE

Turner (2007) proposes that human emotions are directly linked to the social environment inhabited by individuals. He argues that the primary emotions are directly and indirectly influenced by social structures, including macro-structure, meso-structure and micro-structure. As individuals living in a society, we are interactive social beings taking part in the immediate micro-social structure of family, organisation and country, the meso-structure of our jobs and finally the overarching macro-structure of politics, economy, and religion. These structures symbiotically exist in relation to an individual.

Turner’s (2007) views are relevant in the context of Bhutan’s developmental philosophy of Gross National Happiness (GNH). In order to arouse happiness within the citizens of Bhutan, the government has structured the macro and meso social structures in line with the philosophy of GNH. For instance, in 2008, the fourth King of Bhutan gifted his subjects with a freedom to form their government. Bhutan ushered in its
second parliamentary form of government in 2013 since the institution of the
democratic form of government in 2008. But the irony is still that a major section of the
society is sceptical about this form of government and not very conversant with their
voting rights. This has resulted in conflict, division within family members and
defamation of party members and its supporters.

Bhutan considers education as key to the success of the GNH policy. Perhaps a
closer look into the pre-service teachers’ classrooms might help produce more quality
teachers which in turn would enhance the productivity of Bhutanese citizens to realise
the policy of GNH.

2.5 INTERACTION RITUAL THEORY

Collins (2004) contends that the macro-social structures are the reflection of
micro-social processes. So Bhutan’s macro-social policy of GNH is only possible if it
reflects happiness that exists between interacting participants during micro-social
processes, such as face-to-face exchanges among students and with teachers in
classrooms. Collins contends that in such mutually focussed interactions the participants
become energised and that they seek out more interactions leading to chains of
interaction rituals. If happiness is produced during classroom interactions, these
structures can support the development of macro-social structures such as GNH.

The works of Durkheim (1912/1995) and Goffman (1967) were further expanded
by Collins (2008) to promote sociological understanding of emotional arousal through
social interactions that could be accepted in societally relevant places such as school
classrooms (Ritchie, Tobin, Hudson, Roth, & Mergard, 2011). Interaction Ritual Theory
proposes that successful interactions are:
Occasions that combine a high degree of mutual focus of attention, that is, a high degree of intersubjectivity, together with a high degree of emotional entrainment-through bodily synchronization, mutual stimulation/arousal of participants’ nervous systems - result in feelings of membership that are attached to cognitive symbol [i.e., solidarity]; and result in the emotional energy of individual participants, giving them feelings of confidence, enthusiasm, and a desire for action in what they consider a morally proper path. (Collins, 2004, cited in Ritchie et al., 2011, p. 42)

Collins’s (2004) assumes an interaction as the unit of analysis to understand the production of emotional energy in social contexts such as a classroom. He asserts that successful interaction rituals are characterised by collective effervescence and that a set of conditions such as bodily co-presence, barriers to outsiders, mutual focus of attention, and shared emotion generates collective effervescence and emotional energy in an individual (see Figure 2.1).

<table>
<thead>
<tr>
<th>Ritual Ingredients</th>
<th>Ritual Outcomes</th>
</tr>
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<tbody>
<tr>
<td>Co-presence</td>
<td>Group Solidarity</td>
</tr>
<tr>
<td>Barrier to outsiders</td>
<td>Emotional Energy</td>
</tr>
<tr>
<td>Mutual focus of attention</td>
<td>Sacred Objects</td>
</tr>
<tr>
<td>Shared mood</td>
<td>Morality</td>
</tr>
</tbody>
</table>

**Figure 2.1.** Figure showing successful interaction ritual (Collins, 2004).

In his theorising, bodily co-presence refers to people involved in the interaction having close physical proximity; the idea of barriers to outsiders refers to the boundaries to safeguard participants from outsiders who could weaken the mutual focus of attention and emotion; mutual focus of attention means that people attend to the same activity, and have reciprocal awareness of each other’s attention; and shared emotion refers to the common mood between interacting participants (Collins, 2004). When these four conditions are accomplished, participants experience something emotional together known as collective effervescence. The collective effervescence experienced by participants during social interactions lead to positive ritual outcomes such as positive
emotional energy in individuals (Collins 2004) or positive EC in groups (Tobin et al., 2013), group solidarity, sacred objects, and morality. Emotional energy refers to a strong steady emotion that manifests in rhythmically synchronised body movements, eye contact, and in facial expressions and vocalisations among participants (Collins, 2004); group solidarity that refers to harmonised interests and responsibilities among participants in a group for collective action; sacred objects refer to group goals and ideologies that they want to achieve together; and morality relates to a code of conduct sanctioned and adhered to by a group to generate successful interactions.

People experience social encounters everyday with an up and down flow of emotional energy, valenced both positively and negatively (Turner, 2009). They feel attracted to certain situations and distracted by some. The success or failure of an interaction ritual chain depends on the relationship between their own emotional and symbolic resources with others whom they meet in a situation (Collins, 2004). On the positive side, they may experience the emotions of enthusiasm, excitement, and joy. The positive emotions become intense because of a contagious build up during a successful interaction ritual. Emotional contagion is a process of transference of emotions between participants or groups of people so that people become “infected” with the emotional states (e.g., happiness) of other individuals (Bellocchetti et al., 2013). Teachers and students interact in the classrooms on a daily basis. The success and failure of classroom interactions depends on numerous factors. Classroom interactions can fail when there is a low level of collective effervescence, lack of mutual focus, and shared entrainment resulting in low emotional energy or negative EC. For example, when the teacher relates a scientific phenomenon to a joke, the class breaks into laughter. As the class is infected with a positive emotional state (happiness), the class EC ratings might become positive owing
to emotional contagion. In contrast, the monotonous tone of the teacher’s lecture can bore students and eventually the class EC ratings might become negative.

Students gave their perceptions of class EC by pressing a number (1 – 5) on the clickers. Number 5 on the clicker corresponds to very positive, 4 as positive, 3 as neutral, and 2 and 1 as negative and very negative respectively (see Chapter 4 for details). The mean EC values for the three-minute time intervals were subsequently graphed to capture variation in EC for every time interval for each lesson. Graphs of the mean EC ratings provided a heuristic device for identifying significant classroom events in video data. The shape of the graph was indicative of the variations in EC within a lesson. The peaks of the graphs correspond with positive EC and conversely negative EC with troughs.

A growing body of studies in middle school, high school (Ritchie et al., 2013) and pre-service science teacher education (Bellocchi et al., 2013) in Australia settings has confirmed that the valence of classroom EC is related to the success of classroom interactions (discussed in Chapter 3).

2.6 SUMMARY OF THEORETICAL FRAMEWORK

There are four primary emotions. Satisfaction-happiness is the only positively valenced emotion whereas the other three emotions of aversion-fear, assertion-anger, and disappointment-sadness are negatively valenced. These primary emotions also vary in intensity. A series of elaborations such as pride, dislike, gratitude, and relief are generated by the combination of the four primary emotions.

Expectations and sanctions account for the arousal of emotions in humans. When individuals’ expectations are met, they experience positive emotions and provide positive sanctions; in contrast when they do not measure up to expectations, individuals will experience negative emotions and give negative sanctions.
Collins (2004) Interaction Ritual Theory is a major theoretical framework adopted in this study. It describes four ritual ingredients: Co-presence, Barrier to outsiders, Mutual focus of attention, and Shared mood. The successful combination of the four ritual ingredients produces successful interactions that lead to positive emotional energy in individuals. The frequent repetition of successful interaction rituals leads to interaction ritual chains. During successful interactions there is synchrony in body movements, facial expressions and vocalisations of interaction participants involved in the exchanges generating emotional energy. This collective state of emotional arousal produced by a group is termed as the EC of the class. Individuals may then seek to reproduce successful interaction rituals in future interactions in order to reproduce positive emotional energy. Conversely, it is unlikely for individuals in future to seek out interactions that result in defiance to group symbols and conflict among group members.
Chapter 3: EMOTIONS IN TEACHING

3.1 INTRODUCTION

Notwithstanding the centrality of emotions in science education there has been a dearth of research on the role played by emotions in learning to teach science, how science teachers’ emotional experiences affect their teaching practices, and how the socio-cultural context of teaching interacts with science teachers’ emotions. Despite numerous overhauls of pedagogical approaches in science education there is a concern that such current pedagogical approaches are not motivating for students to study science or reduce science teachers’ attrition. However, a recent study on the emotions of beginning science teachers (Ritchie et al., 2011) and on the emotional climate (EC) of pre-service science teachers’ classes in Australia (Bellocchi et al., 2013) indicate that innovative approaches to the teaching and learning of science are having success in increasing students’ interest in science. This research aims to extend and develop a program of study that will improve the EC of pre-service teachers’ science classes at the Royal University of Bhutan (RUB) and inspire these teachers, upon their graduation, similarly to engage school students in science through more meaningful experiences.

In section 3.2, Metiu and Rothbard’s (2012) model of group engagement which informed my study is reviewed. By drawing on interaction ritual theory, the group engagement model details how specific key elements (e.g., task bubble, use of artefacts, and shared emotion) and enabling conditions (e.g., individual engagement, compelling directions, informal interaction style, and frequency of interactions) facilitate group engagement. The model was developed to explain the way in which software developers
working in software development projects in the US accomplished group goals. I present a refinement of the model in Chapter 7 based on the outcomes of my study.

Section 3.3 examines literature on the recent studies in science education on emotions and EC that pertain to specific components of Metiu and Rothbard’s model. Section 3.4 details other relevant literature to my study on the emotions expressed by teachers and science teachers as they engage in classroom teaching. The discussion overviews a myriad of research carried out on teachers’ awareness of their emotional experiences that extends beyond Metiu and Rothbard’s model. Research focusing on classroom EC is reviewed in Section 3.5. A specific focus on EC and emotion research in science education is reviewed in Section 3.6. Section 3.7 examines the EC in pre-service teacher education. Specific issues (teacher as reflective practitioner and pedagogy in the science classroom) arising from the literature that are related to the present study are discussed in Section 3.8. The chapter concludes with a summary in Section 3.9.

3.2 THE GROUP ENGAGEMENT PROCESS MODEL

Metiu and Rothbard (2012) examined how individuals working in two software development projects called Shield and Gateway in the US developed and maintained mutual focus of attention on a shared task. Their study adopted ethnographic methods to compare group engagement in these two projects using direct observations supplemented by interviews.

They employed Glaser and Strauss’s (1967) method of comparing and contrasting work episodes and interpretations of various interactions to analyse their data. The study provided an in-depth analysis of the process of group engagement, how it developed, what conditions enabled its development, and its consequences. The key elements that
facilitated the group engagement process were evident in the interaction episodes that took place between group members as reflected in the model in Figure 3.1.

In Figure 3.1, the factors that led to mutual focus of attention between group members are enclosed within the dashed oval under the heading *interaction episode*. The enabling conditions that influence interaction among members and develop mutual focus of attention are displayed to the left of the oval.

![Figure 3.1. The group engagement model (Metiu & Rothbard, 2012).](image)

The model specifically shows that the group interactions where participants developed high levels of mutual focus of attention were characterised by three factors: the presence of a *task bubble* that created a barrier to outsiders, enabling members to develop intense mutual focus of attention on a given task; effective *use of artefacts* that helped members develop shared understanding and maintain a common focus of attention; and *shared emotion* that reinforced mutual focus of attention and sustained each member’s ability to continue to engage in intense group interactions over time. The close analysis revealed that most of the factors that characterise the group engagement
process relate very closely to Collins’s Interaction Ritual Theory (Collins, 2004) except for task-related artefacts that arose inductively from their observations of the work context. For this reason, Metiu and Rothbard (2012) included “task-related artefacts” as they help to generate mutual focus of attention and shared emotion among members who were co-present as well as among members who were distantly located.

The model also reveals that the process of group engagement was more likely to unfurl in the presence of several enabling conditions operating at three levels of analysis namely; the individual, the interaction, and the project level. At the individual level, the participation of an individual is considered important as an enabler of the group engagement process. The frequency of interaction and informality of interactions were considered as a critical enabler of the group engagement process. Finally, at the project level the compelling direction provided motivation and direction to the participants that enabled the process of group engagement. Compelling direction refers to an inspiration that gave participants a vision of the collective goal of what they yearn to achieve collectively (Metiu & Rothbard, 2012).

*Individual engagement* refers to individual members deeply engaged with their individual tasks which would apparently lead to group engagement and contribute to numerous subsequent interactions. For any group engagement process (i.e., engagement of individuals with one another) recognition of individual-level factors; group member motivation and engagement with work roles are important (Kahn, 1990; Rothbard, 2001), specifically if one is dealing with innovative work and aspiring to achieve a breakthrough. *Compelling direction* refers to an inspiration that instils in the workers a passion and energy about the tasks and wanting them to contribute to the tasks collectively. The other condition that supported group engagement processes was the informality of interactions. *Informality of interactions* in the context of this study refers
to informal conversations where participants can share information openly, clarify doubts, and solve problems amicably. *Frequency of interaction* was both an indicator and a source of high levels of mutual focus of attention. In other words, there should be frequent interactions in order for the mutual focus of attention to develop.

This model gives new insights into what members in any organisation should do in order to focus collectively their efforts and engage with one another to solve problems. For instance, a common focus on an artefact not only develops mutual focus of attention in a group but it has the ability to generate and sustain group interactions in a way that facilitates understanding and enhances mutual focus of attention even when members are not physically co-present. Secondly, the shared emotions that result from interactions through emotional contagion (Barsade, 2002) also help to sustain frequent and extended interactions which play an important role in enhancing the group engagement process (Barsade, 2002; Totterdell, 2000). Shared emotion refers to the common mood that the participating members experience in interactions (Metiu & Rothbard, 2012). Moreover, mutual focus of attention seemingly enhances shared emotion, which in turn sustains mutual focus of attention over time leading to successful interactions and effective problem solving. For example, after an episode of mutual focus of attention that led to accomplishment of a task, the participants expressed a shared emotion and sought similar interactions in the future (Metiu & Rothbard, 2012). Thirdly, frequent informal interactions and compelling directions generate mutual focus of attention among members engaged in the group process. Metiu and Rothbard (2012) assert that the frequency of interaction was both an indicator and a source of mutual focus of attention. In other words, there should be interactions in order for the mutual focus of attention to develop. For instance, in Metiu and Rothbard’s (2012) study, the developers at Shield were interacting by visiting each other’s offices,
asking questions and sharing views, providing suggestions, helping each other and
gearing towards the success of the overall project. Such dynamics were missing at
Gateway.

Although the idea that a task bubble as a permeable boundary generated mutual
focus of attention among group members in Metiu and Rothbard’s study, it may not
generate similar mutual focus in the Bhutanese college/school context as the students
would feel apprehensive in the presence of outsiders.

The model represents the study of how members working for a software company
achieved a breakthrough. Their findings which are reflected in the model revealed that
to achieve a breakthrough the members in the group must be engaged in interactions and
generate mutual focus of attention on the given task. Drawing a barrier that kept
outsiders at a distance so they would not interrupt the interactions of group members
facilitated the establishment of mutual focus of attention. The presence of artefacts
helps members to engage in the work even if they are placed in different locations. The
emotions that they have generated by working together reinforced the mutual focus of
attention and also sustained shared emotion among members. However, the presence of
a task bubble, artefacts, and shared emotion does not guarantee mutual focus of
attention unless fuelled by certain enabling conditions. For instance, unless an
individual participates in an interaction, the group engagement process will not
commence which is a key to the generation of mutual focus of attention that leads to the
accomplishment of a task. Similarly, an individual’s engagement in the interaction does
not result in positive shared emotion or mutual focus of attention unless the interactions
are more frequent, informal and influenced by compelling direction of the assigned task.

This section gave an overview of the group engagement process model. The
following section (Section 3.3) reviews literature on recent studies of emotion in science
education and EC that illustrate specific components of the group engagement process model.

3.3 LITERATURE RELATED TO THE GROUP ENGAGEMENT PROCESS

MODEL

Metiu and Rothbard’s (2012) model draws on Collins’s (2007) Interaction Ritual Theory and illustrates how three elements; task bubble, task-related artefacts, and shared emotion, constitute the group engagement process. The model also specifies four enabling conditions (i.e., engagement of an individual in the task, compelling directions, informal and frequent interactions) that are required for group members to develop a shared focus of attention during collaboration. In the sections that follow, I review studies on emotion and EC that illustrate specific elements and enabling conditions of the group engagement model.

3.3.1 Task-related artefacts

Swarat, Ortony and Revelle’s (2012) study with middle school science students in the US revealed that students get excited while performing an experiment (i.e., play with artefacts like science instruments) and get bored during a lecture regardless of what the lesson topic is about and why they are learning about it. For instance, Swarat et al.’s survey findings of 533 students indicate that students prefer hands-on activities involving experiments, laboratory work, and technology involving computers and videos than mostly cognitive activities such as reading, writing, and listening to lectures. Their follow up interview with 10 students is consistent with the above findings. For instance, students unequivocally stated that hands-on activities and the use of technology were largely positive experiences whereas cognitive activities were uninteresting. This observation was consistent with previous reports on the positive
impact of technology-enhanced instruction on students’ interest and motivation (Mitchell, 1993) as well as on other learning outcomes (Lee, Linn, Varma, & Liu, 2010).

Similarly, Palmer’s (2009) study of grade 9 Australian students’ interests in science lessons found that student interest was much higher during the experiment and demonstration phase than during the proposal or report writing phase. By the same token, Mitchell’s (1993) focus group and self-report questionnaire study found that high school students showed more interest in math and science when integrated with artefacts such as puzzles and computers.

In another study (Ritchie et al., 2011) of grade 7 students and their teacher in an Australian science class, artefacts like video cartoons that the students watched in previous years helped one of the students to connect the present science topic “where does water come from?” to the cartoon movies as evident in the following interactions between Vicky (teacher) and Trish (student).

01 Trish: ()
02 Vicky: A weird documentary thing
03 Trish: Yeah (.) in year 5 and 4 and there was this cartoon (.) and the water goes up into the sky and in the clouds and turns to ice (.) then it started falling
04 Vicky: Was it ice when it fell?
05 Trish: Yup and it started falling and then because it got hotter and hotter (.) hh and the water (.) the hail turned to water and rained. Big chunks turned to rain

(Ritchie et al., 2011, p. 755)

In the transcript, the cartoon (i.e., video artefact) became a resource that scaffolded the student’s understanding of rain formation.

3.3.2 Compelling direction

Compelling direction refers to an inspiration that instils in the workers a zeal and energy about the tasks and wanting them to contribute to the tasks collectively (Hackman, 2002). The study by Metiu and Rothbard (2012) showed that the presence of
compelling directions gave the workers a vision of the collective goal of what they desired to achieve. As a consequence of this direction, the workers proactively reached out to one another and interacted willingly and spontaneously in coordinated ways as they tried to solve problems. Conversely, the absence of compelling directions left the developers in confusion and failed to achieve their desired goal.

Similarly, the compelling directions helped four Australian beginning Physics teachers accomplish success with an Extended Experimental Investigation (EEI) of grade 11 students (Ritchie, Tobin, Sandhu, Sandhu, Henderson, & Roth, 2013) despite experiencing fear initially instilled by senior colleagues and witnessing senior colleagues having a breakdown while implementing EEIs or students panicking about their success with an EEI.

All four teachers were pleased with the outcomes of their EEIs. The success of EEIs was attributed to compelling directions such as the teacher providing details of expectations for presentation and assessment to the students. For instance, each teacher had a milestone set for their students such as maintaining a log book, having to submit three drafts before the final draft, and students were made responsible for designing the procedures of the inquiry. One teacher recounted that she had amazing student outcomes in report writing in her class after she made sure that she read three drafts of each report before the final submission. This support pushed these students to work well and really hard.

Moreover, the earlier bitter experiences with senior colleagues and students compelled these teachers to prepare and focus on the management of the EEIs. Besides, the topics for EEIs were related to everyday Physics, and most of the students could choose from a list of topics.
So it was the direction of the project or the lesson that was an important enabler of the group engagement or interaction process as motivation and effort came from the way people interacted and helped one another. The other condition that supported the group engagement process is the informality of interactions as detailed in the following section.

3.3.3 Informality of interaction

Informality of interactions refers to informal conversations where participants exchange information openly and mutually to solve problems (Metiu & Rothbard, 2012). Metiu and Rothbard’s study revealed that informal interactions created intimacy among members by placing them at a comfortable position and engaging them in the task bubble where open and rich exchanges took place leading to mutual focus of attention and shared emotion.

Similarly, an informal activity in Bellocchi et al.’s (2013) study with B.Ed secondary pre-service science teachers generated positive EC. The informality of certain interactions served to make the EC more positive. Following a first debate session on the given science topic as a part of class activity between two groups, the idea to vote in order to identify winners of the debate arose spontaneously. The lecturer initiated the voting by making the statement ‘‘so I think we definitely have to go to an audience vote on this, whaddya reckon?’’ (p. 23).

The lecturer’s remark on the need to go for an audience poll and the use of the colloquial expression whaddya reckon indicates that the invitation to vote was an ad-hoc decision. The informal expression used by the lecturer helps build intimacy and complicity between the lecturer and students which resulted in free and open interaction.
The study of a beginning science teacher and her grade 7 science students from a middle school in Queensland (Tobin et al., 2013) indicates that the informal interactions that ensued from a role play between the teacher and one of her students (Trent) were characterised by an interpersonal closeness and high emotional energy. The interactions during the role play were positive as the teacher and Trent were in synchrony as their conversations were dialogic and fluent rather than the teacher dominating the talk. Their interactions were characterised by the teacher’s frequent laughter, clapping of hands, and the teacher and students mimicking each other. These features on the interactions signalled that traditional power structures pertaining to teachers and students were suspended at least for this activity.

Furthermore, Trent used nasal accented speech and expressive gestures while enacting the role of an old science professor during role play, an indication that Trent was feeling free and enthusiastic about his part as a scientist in the role play. The hilarious laughter of the teacher that may have been excited by Trent’s nasal accented speech appeared contagious which sent the whole class into laughter.

In contrast, formal interactions involve dissemination of information instead of open exchange of ideas that lead to mutual focus of attention. It does not allow for open exchanges of ideas and it mostly constitutes pre-scheduled meetings which are time bound (Metiu & Rothbard, 2012). By the same token, in Tobin et al.’s (2013) study during a session focussed on the relationship between the boat design to density and buoyancy, interactions were more of teacher-centred. The EC was negatively valenced and the verbal interaction was not as dialogic as in the previous session. The pattern of verbal interaction was more of an initiate-respond-evaluate pattern (see Bellocchi et al., 2013) with the teacher asking a question, students providing a response and the teacher taking further actions on the response.
I have described the relevant science education literature related to Metiu and Rothbard’s (2012) group engagement model in this section, now I present a broader review of other studies that informed my understanding of emotions and EC of science teachers and pre-service science teachers in Section 3.4.

### 3.4 THE EXPRESSION OF TEACHER EMOTIONS

Teachers’ emotions are inextricably associated with teachers’ work, growth, and identity (Hargreaves, 2005) and how these emotions impact teachers’ lives (Liston & Garrison, 2004; Zembylas, 2005a). When teachers are asked what they find satisfying about their jobs, they talk about excitement derived from interacting with students and establishing emotional bonds with them, and the curiosity of understanding each student and their background (Kelchtermans, 2005). Conversely, many teachers feel uncomfortable dealing with some of the stressful aspects of teaching science (Nichols & Tippins, 2000; Winograd, 2003). For instance, teachers can experience negative emotions such as; frustration, anxiety, guilt, anger, fear, embarrassment, and feelings of loneliness and powerlessness as a result of their lack of science content knowledge (Zembylas & Barker, 2002a); lack of emotionally conducive working conditions (VanBalkom & Sherman, 2010) and problems with classroom management (Winograd, 2003). Moreover, though teachers play a crucial role in implementing educational change, teachers’ voices and perspective are frequently ignored in implementing educational changes (Bailey, 2000). The following section details teachers’ awareness of their emotional experiences.

#### 3.4.1 Teacher Awareness of their Emotional Experiences

Traditionally, emotions have been seen as the converse of the enlightened ideals of reason and rationality. As Oatley and Jenkins (1996) argue, “there is suspicion in
Western culture that there is something wrong with emotions” (p. 38). For Westerners, emotions are often thought of as an unmanageable state, having a troublesome, adverse influence on thinking and behaviour (Forgas, 2000). Emotions, according to this view, are impediments to considered decision-making and intellectual activity. Emotional expression has also been linked to uncivilised, primitive or childish behaviour including vulgarity.

Whilst the traditional academic view has seen a separation of cognition and emotion, an alternative view argues that the expression of one’s feeling is a useful, even essential requisite to rationality and to effective social thinking (Forgas, 2000; Oatley & Jenkins, 1996). As Denzin (1984) suggests:

> Emotionality lies at the intersection of the person and society, for all persons are joined to their societies through the self-feelings and emotions they feel and experience on a daily basis. This is the reason the study of emotionality must occupy a central place in all the human disciplines, for to be human is to be emotional. (p. 10)

Emotion has been neglected as a field of study within teacher education (Spillane., Reiser., & Reimer, 2002; Zembylas, 2002) despite the central role that emotion plays in everyone’s life. The study on teacher emotions and the significance of emotions in the teaching profession escalated in the last few years.

Teachers experience a myriad of emotions as they interact with students and other colleagues at their workplace on a daily basis. Hargreaves’s (1998) interview study of 32 junior school teachers about their perceptions of the curriculum and assessment reforms of the Canadian school system reveals that all aspects of teaching including interaction with students, dealing with pedagogy and curriculum, lesson planning and executing lessons involved emotional experiences.
Teaching can be a very noble and gratifying profession and many teachers are aware of that Kelchtermans’s (1996) analysis of Belgian primary school teachers’ professional biographies reported that, many teachers refer to feelings of excitement, fascination, pride, wonder, and enthusiasm resulting from the fact that they work with 'human material' (p. 307). Teachers' talk about their profession reveals that emotions are at the heart of teaching. Similarly teachers in Hargreaves’s (1998) study shared their success stories working with students. For instance, instances of contentment were shown by teachers when students learn and progress academically, especially in cases of students who struggled initially.

Teaching also entails feelings of disappointment, stress, guilt, and even anger and fear. However, slight attention was paid to the negative emotional arousal of teachers in Kelchtermans’s (2005) study. Kelchtermans argued that vulnerability in teaching affects teachers' job satisfaction and the quality of their professional performance. The investigation of the professional biographies of primary school teachers showed that a sense of vulnerability can be triggered by a variety of sources such as; their struggle to impact on students' learning in the classroom; dealing with school administrators, colleagues and parents; and educational policies. Hargreaves made a brief mention of few of his teachers expressing their exhaustion and stress working with students occasionally.

Day and Leitch (2001) presented numerous narrative accounts of teachers’ negative experiences. Day and Leitch (2001) contend that how teachers conduct themselves in the classroom is influenced by teachers’ “emotional self” (p. 407). In other words teachers’ desire for their work and concern for their students influenced their emotional arousal in reaction to interactions and events that unfolded at school. For instance, one teacher in Day and Leitch’s study narrated an incident where a student
revealed that she was beaten by her father. This news drained the teacher emotionally and he went out of his way to deal with the relevant organisation to help his student.

School reforms have also been shown to evoke teachers’ unpleasant emotions (Day & Leitch, 2001; Zembylas & Barker, 2007). After interviewing teachers in England and The Netherlands, Day and Leitch (2001) found that many teachers were exhausted from their struggle with reform movements. School reforms have also led to burnout among teachers (Leithwood, 2007). Burnout is defined as a symptom of emotional depletion and a loss of motivation and commitment (Chang, 2009). For instance, when people claim that they are experiencing burnout, they most often refer to the experience of emotional exhaustion (Maslach, Schaufeli, & Leiter, 2001). A study by Evers, Tomic, and Brouwers (2004) referred to emotional exhaustion as feelings of being emotionally over extended and having depleted one’s emotional resources, while Schwarzer, Schmitz, and Tang (2000) described fatigue, weakness, loss of energy, and weariness as characteristics of exhaustion.

Although emotional exhaustion is one of the most recognised aspects of teacher burnout; teachers’ emotions and emotional regulation have been surprisingly disregarded (Carson, 2006; Zellars, Hochwarter, Perrewé, Hoffman, & Ford, 2004). In order to deal with these emotions and other complex social interactions, teachers are required to draw on their intellectual and emotional resources (Day, Sammons, Stobart, Kington, & Gu, 2007; Woolfolk & Davis, 2005). The understanding of emotional aspects of teaching may help us to understand why teachers feel emotionally exhausted (Day & Leitch, 2001).

In conclusion, the negative impact of reform on teachers’ lives is summarised by Wexler (2002) who noted:
incorporating school reform into the working day of teaching requires not only expertise and sagacity. It is an enormous amount of often-frustrating additional work that is taken on by teachers, sometimes as an organic, professional innovation and, at other times, as a no less professional adaptation to an external imposition, which becomes part of a changing definition of ‘good’ professional performance. (p. 471)

Sutton and Wheatley (2003) have compiled a helpful review of the emotional aspects of teachers’ lives. Student misbehaviour, for example, elicits negative emotions in teachers because it distracts attention from instructional goals. One teacher expressed this unsurprising association as follows:

When students are doing [mischief], we’ll call it negative behaviour, it distracts me from what I’m trying to think through. If I’m trying to explain something and there’s negative behaviour … it breaks my concentration and then I have to refocus myself. (Emmer, 1994, p. 3)

Several studies report that it is the social and emotional aptitude of teachers that makes them approachable and have positive regard for students including warmth and respect (Jennings & Greenberg, 2009; Wilson, Pianta, & Stuhlman, 2007). Students are more likely to reap a good learning experience when taught by such enthusiastic teachers. For instance, a survey questionnaire administered to 71 teachers and over 1000 students across Germany to investigate the relationship between teacher enjoyment and student enjoyment during mathematics lessons found that there was a positive relationship between teacher and student enjoyment (Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009). This relationship was mediated by teachers’ displays of passion and interest during teaching.

Furthermore, teachers who experience more positive emotions such as joy, interest, pride, and love enhance students’ thinking ability (Fredrickson & Branigan, 2001); in other words, “more thoughts and actions come to mind” (Fredrickson, 2001, p. 471).
For example, Fredrickson (2001) found that teachers who viewed a short film that aroused positive emotions generated more ideas than those who saw a clip that evoked negative emotions. This implies that teachers who experience more positive emotions may produce better teaching strategies; they may also develop “broad minded coping” skills (p. 223), which can help them manage problems. Such processes can enhance teachers’ competence in their classroom experience (Sutton & Wheatley, 2003).

A teacher with emotional awareness who understands his/her own and their students’ feelings is in a position to mitigate negative emotional consequences. Emotionally proficient teachers should be able to analyse the emotional difficulties that typically trigger disruptive and challenging behaviours of the students (Jennings & Greenberg, 2009). The teacher participant in Zembylas’s (2004a) three-year ethnographic study described how Catherine (a pseudonym) was able to triumph over negative emotional experiences experienced by students by creating a positive classroom climate through emotional displays and modelling excitement about science activities.

In the United Kingdom, the Department of Education and Skills [DfES] commissioned a study about students’ and teachers’ emotional and social competence and well-being. The study reported that practitioners cannot transmit emotional and social competence and wellbeing effectively if their own emotional and social needs are not met (Weare & Gray, 2003). The study also reported evidence that “only a small number of teachers appear to be in favour of work to promote emotional wellbeing and that the majority are reluctant to get involved, in part because they are not trained in how to do it” (p. 74). The study also recommended that the DfES explore the possibility of developing work on teachers’ emotional and social competence and comfort, both for schools and for teacher education institutes. The study recommended that teacher
education programs and schools needed to address emotion in education in more explicit ways.

In contrast to studies that employed interviews and questionnaires, Winograd, a senior university faculty, carried out a self-study of his homecoming to the classroom during his year-long sabbatical leave. He maintained a journal to record an anecdotal account of his emotional experiences as the lesson unfolded in the classroom (Winograd, 2003). In this study, he expressed his guilt and frustration occasionally for not doing justice to his teaching. He equated himself to a novice teacher and reported feeling inadequate in his role as a teacher.

I was (like) a beginning teacher with a difficult class, so it is natural that I would question my competence when I had the inevitable problems with classroom management and teaching. Often, I felt embarrassment, anger, fear, and anxiety as it relate to my teaching performance and my perception of how my colleagues and parents viewed me as a teacher. (p. 1668)

However, Winograd would have different expectations than novice teachers on his return to teaching.

The study of teacher awareness of their emotional experiences highlights the significant role that emotions play in the classroom and in student-teacher interactions. The next section reviews research related to emotional experiences of science teachers.

3.4.2 Science Teachers’ Awareness of their Emotional Experiences

Although my study explored the lived experiences and emotions of pre-service secondary science teachers, comparisons between the experiences of school science teachers and pre-service teachers about to enter the teaching profession were informative.
To be effective science teachers, one must be proficient in pedagogical skills as well as content knowledge of the subject. It is often reported that secondary science teachers are more versed in science content than primary teachers who are inadequately prepared to teach science effectively (Ginns & Watters, 1996; Zembylas & Barker, 2002a). This disparity in their preparation as science teachers can impact their teaching of science subjects in future. For instance, the deficiency of adequate science content knowledge attributed to the feelings of anxiety and apprehension in primary science teachers (Ginns & Watters, 1996; Zembylas & Barker, 2002a) and this contributed to their lack of interest in science and science teaching (Jarrett, 1999). Whereas it is expected that secondary science teachers would have more confidence to teach science owing to their adequate content knowledge.

In the context of Bhutan, primary teachers are specialised to teach primary science while secondary teachers are trained to teach sciences at the secondary level. The problems arise when primary teachers are made to teach secondary sciences (Fahmi, 2008) as their only background in science is the experiences garnered at the school as students and few science modules focusing on the primary curriculum while at the college. This is consistent with Powell’s (1997) study of two novice science teachers using multi data sources. One of the teachers resorted to teacher-centred class where she disseminated information directly from the textbook and students took copious notes from the board as she was assigned to teach a subject which was outside her area of expertise. This also coheres with Watson’s (2006) argument that teachers are worried when they are made to teach a subject which is not their area of specialisation. So it can be inferred that the dearth of scientific content knowledge, can not only upset teachers’ self-confidence, but also their pedagogy.
Similarly, the feelings of concern about science content knowledge also are evident even among many secondary teachers in Bhutan. Many practicing science teachers have formal science backgrounds limited to grade 12 (Rinchen, Tshering, Jose, Gyeltshen, & Gyeltshen, 2011). Even in Australia 13% of secondary science teachers do not have science as a major area of study in their pre-service teacher education program (Martin et al., 2000).

Although many teachers blame themselves for their inability or failure to deliver well, there are some teachers whose negative experiences prompted positive changes to their teaching pedagogy. For instance, Demetriou and Wilson (2009) reported that some of the beginning teachers whom they interviewed in their study expressed that they were able to make positive changes to their teaching pedagogy even though they attributed problems in their classroom such as low student motivation to themselves. These beginning teachers empathised with the students’ low motivation and engagement and made effective changes to create an engaging learning environment.

Similarly, Catherine (primary science teacher), the teacher participant in Zembylas’s (2004a) three-year ethnographic study, narrated how she was able to overcome negative emotional experiences. Catherine expressed that at the outset of her teaching career she was overwhelmed by strong negative emotions about the culture of testing that was being practised in her school. Catherine sensed that the culture of standardised testing and the resources marked to bring improvement in test scores, undermined her philosophy of student-centred approach of learning. She perceived that her prior goals in teaching science were being opposed and were not parallel with the priorities of her school, which makes her sad, guilty and shameful. Catherine attributed these negative emotions to her perceptions of being a useless and unworthy teacher. Overcoming emotional hindrances through seeing the positive learning outcomes of her
students and gaining a deeper understanding of her emotions, allowed Catherine to diminish her feelings of shame and failure (Zembylas, 2002). Hereafter, Catherine focused upon positive emotions related to her teaching and interactions with students, and continued to create an intellectually and emotionally supportive classroom learning environment for her and her students. The interactions between Catherine and her students showed that shared positive mood, mutual focus and the synchronisation of talk and body movements can be described as indicative of successful interactions (Zembylas, 2002).

The previous section discussed teachers’ awareness of their emotional experiences garnered from their interactions with students, curriculum, pedagogy, and assessment. The next section reviews research related to classroom EC and emotion research in science education.

3.5 EMOTIONAL CLIMATE OF THE CLASSROOM

The term classroom climate was used for the first time in the late 1960s by Walberg and Anderson (1968) in pursuit of assessing students’ perceptions of their educational experience. However, the first researcher to popularise the concept of classroom climate was Moos (1973). Evans et al. (2009) identified three dimensions of classroom climate: Academic, referring to pedagogical and curricular elements of the learning environment; management, referring to discipline styles for maintaining order; and emotional, the affective interactions within the classroom. The emotional dimension is of high relevance for this study which is discussed in this section.

Evans et al. (2009) have identified five elements of emotional climate. These are emotional relationship, emotional awareness, emotional coaching, emotional intrapersonal beliefs, and emotional interpersonal guidelines.
Emotional relationship pertains to the bond between teacher and student which is critical to EC in the classroom (Harvey & Evans, 2003). For example, EC in the context of education indicates how teachers and students create the conditions that shape how they are emotionally connected and engaged in learning together (Argyris, 1999).

Emotional awareness relates to teachers being able to understand and manage their own emotional reactions to situations and being able to differentiate students’ emotions and their causes (Harvey & Evans, 2003). Cultural differences in emotions are seen as a result of orderly differences in the perception and interpretation of the same events (Mesquita & Ellsworth, 2001). Teachers, like other individuals, do not experience the same emotion under the same external conditions. For instance, a student who avoids assigned classroom tasks may trigger anger in one teacher and sadness in another (Sutton, 2000).

Emotional coaching deals with helping students to manage or regulate their own emotions (Gottman, Katz, & Hooven, 1997). Emotional competence was crucial for positive outcomes in both social and academic domains (Denham, 2006). Helping students find better ways to interact with their peers improved regulation of their behaviour which supported their social, emotional, and academic pursuits throughout their life (Denham, 2006).

Emotional intrapersonal beliefs describe a wide range of ideas about emotions from which teachers compose their emotional philosophy (Katz & Windecker-Nelson, 2004). Anxiety about meeting a new class, nervousness about a particular lecture, excitement about a group activity, or concern for troubled students, all relate to teachers’ intrapersonal beliefs (Chang, 2009; Schutz & Zembylas, 2009).

Emotional interpersonal guidelines relate to emotional boundaries and standards needed within the classroom such as fairness, consistency in routine and structure, and
exercising discipline. A study by Hamre, Pianta, Downer, and Mashburn (2007) was based on the teachers’ perceptions of conflict with young students and looking beyond problem behaviours. Older students were more likely to have relationships with teachers that involve conflict based on their behaviour. Teachers with low self-efficacy and less emotional support tended to report more conflict with students in a classroom (Hamre et al., 2007).

Hamre and Pianta (2005) observed that classroom instructional and emotional support produce positive results in terms of academic adjustment for students. Even though emotional and instructional support are related, the classroom EC is expected to have a greater impact on students’ relationships with teachers and peers because it refers more specifically to the social interactions within the science classroom as discussed in Section 3.6.

3.6 EMOTIONAL CLIMATE AND EMOTION RESEARCH IN SCIENCE EDUCATION

The five elements of classroom EC conceptualised by Evans et al. (2009) as discussed in Section 3.5 represent various factors that can shape the interactions in a classroom. Classroom transactions involve ongoing dialogue among students and between students and their teachers; hence classroom EC can fluctuate moment-by-moment during interactions as individuals’ expectations are met or unmet, and as different sanctions are exchanged.

The work on teacher emotions in science education (Barker, 2001; Zembylas, 2001, 2002; Zembylas & Barker, 2002b) is useful in foregrounding the emotional context of teaching. Zembylas (2001, 2002) argued that positive and negative emotions play a significant role in a teacher’s construction of his or her science pedagogy, curriculum planning, and relationships with children and colleagues. He emphasised
how the emotional aspects of the science-teacher self in becoming or being a science teacher, the acquisition and use of pedagogical approaches, and the application of professional judgment in practice are inextricably linked.

Tobin et al. (2013) employed analytic procedures such as conversation and prosodic analysis to study the impact of interactions on the EC of a science classroom. They found that successful interactions were more dialogical, and choral responses, clapping, and laughter were also evident in successful interactions leading to collective effervescence (Collins, 2004) of shared emotion and heightened mutual awareness.

Collins (2004) too asserts that participants feel a sense of belongingness or solidarity to a given group after prolonged successful interactions. Group solidarity in the classroom is evident when there is synchronisation of talk and facial cues between students and teachers (Tobin, 2006). The relationships that are established and the interactions that occur between students and teachers are an integral part of the classroom (Pianta, 1999; Zull, 2002). Within those interactions there is reciprocity between participants; a give and take of ideas through conversation (Jingbo & Elicker, 2005; Pianta, 1999).

Occurrences of negative classroom EC were also identified in Tobin et al.’s (2013) study. Negative instances occurred when conversations among students and between students and teachers were either one sided or needed more prompting by the teacher. In such interactions, shared mood was not established as the participants in the interaction do not have a mutual focus and lack synchrony of talk and body movement (Collins, 2004). Unlike in the West, Bhutanese classrooms seldom experience students giving spontaneous choral responses. Denial of choral responses during interactions is an academic mandate (SCE, 2005) as it would not only blur the on-going interactions but signify indecency on the part of students too.
A study by Wentzel (1998) found that students were well behaved, motivated, and cooperative in classrooms when their teachers cared about them. Establishing a strong rapport and open communication with students was viewed as an important pedagogical tool across all teaching domains. The same view was shared by Demetriou and Wilson (2009) in their study of school science teachers. They found that the positive rapport with students helped teachers to captivate the students’ interest and activate their science learning.

EC of the classroom is dependent on the social and emotional competence of the teacher in managing the variety of complex interactions with each member of the class in an impartial manner (Jennings & Greenberg, 2009). The use of humour and laughter by teachers can encourage students to contribute more openly to science-related discussion in class (Ritchie et al., 2011). When the teacher laughs at his or her own mistakes, students can feel more comfortable in taking risks such as expressing their ideas about science concepts in class. Laughter establishes or restores a positive EC and a sense of connection between people, making them take pleasure in the company of each other. Laughter is not mainly about humour but about social relationships (Provine, 2004). Roth, Ritchie, Hudson, & Mergard (2011) asserted humour and laughter help the shy students in the class to participate with the group, to feel part of the class and possibly contribute without feeling vulnerable. It is a way of reaching out to those students who are too afraid or worried to attempt expressing themselves.

There are three fundamental characteristics and functions of laughter in science learning (Roth et al., 2011). Laughter is interactive, as it is produced by the people involved and the type of circumstances they are in; laughter plays a role in both challenging and reaffirming the relationship between knowledge and power and suspends the traditional power structure present in the science class; and laughter
creates intimacy, complicity, and solidarity as a part of the learning environment that fosters engagement and interest. Segregating “scientific talk” from everyday life does not reflect the reality of science learning. Instead, it mediates classroom proceedings and the learning that emerges so it should not be dismissed as irrelevant (Roth et al., 2011).

In Bhutan, students come to the class with different behavioural patterns as a result of having to cope with emotions experienced in their home lives due to missing breakfast, not having taken a shower because of water shortages, or having a sleepless night because of a disturbance in the hostel the previous night. In addition, lack of basic comfortable seating, inadequate lighting and ventilation, uncomfortable room temperature, and un-aesthetic classroom milieu can jeopardise learning and creative thinking. But emotionally supportive classrooms encourage students to feel comfortable and safe to articulate their thoughts and feelings while engaging in science learning (Zembylas, 2004a).

3.7 EMOTIONAL CLIMATE IN PRE-SERVICE TEACHER EDUCATION

Studies of EC pertaining to teacher education have relied mostly on surveys and interviews of recent graduates, teachers, and principals, neglecting the voices and lived experiences of pre-service teachers. A critique of studies carried out with pre-service teacher classes, relevant to my study, is presented below.

As documented in science education literature (Anderson, Smith, & Peasley, 2000; Nichols & Tippins, 2000) pre-service elementary teachers experience negative emotions such as discomfort, anxiety, alienation, fear, and frustration when teaching science. The major reasons to explain these negative emotions include; pre-service teachers’ lack of science content knowledge, which is a source of emotions of alienation and discomfort; lack of an emotionally supportive learning environment; pre-service
teachers’ past negative experiences of school science which leads to emotions of exclusion and frustration; and disengaging pedagogies. For example, Rice and Roychoudhury (2003) conducted a study with 52 pre-service teachers to garner their perceptions of their readiness to teach a science module which they had recently completed at the university. The students’ response indicated that most of them were apprehensive about their ability to handle teaching science in schools and this was a significant area of concern for their future endeavour. The researchers recommended that further research be undertaken in the area of pre-service teacher education to enhance the quality of science teaching.

Zembylas and Barker (2002a) argued that changing the valence of pre-service teachers’ emotions so that they become more positive would help an elementary teacher to teach science. They set out to transform 60 pre-service elementary teachers’ attitudes to science by structuring the course around practical, hands-on activities that engaged the students actively in class at a Midwestern Public University in the United States of America. These researchers interviewed all participants. They also invited participants to record their reflections of class experiences in a diary. Data from only two pre-service teachers; namely, Jenny and Scott (both pseudonyms) were presented as case studies to draw attention to what specifically can be learned from the in-depth study of cases.

Based on their analysis of these data, they concluded that, by the end of the course, both Jenny and Scott expressed improved levels of interest in science and science teaching. The researchers further argued that the reflective writing activities in the course motivated students to examine their experiences encountered in schools and evaluate the effects it had on students’ feelings towards science. For example, they quoted the following excerpt from an interview with Jenny to support their case:
by examining these experiences, I discovered which of them positively or negatively affected my life. Reflecting on this, I was able to realise that I had positive experiences when my teachers made me like science through various projects and experiments; the few negative experiences that I had were because a teacher disliked science and made it boring for everyone else. (Zembylas & Barker, 2002a, p. 338)

The study outlines the importance of creating emotionally supportive environments for the development of positive attitudes and professional knowledge of pre-service teachers. Both Jenny and Scott enriched their understanding of science and science teaching emotionally and intellectually; they made connections between their emotions experienced in the course (e.g., emotions of elation and fun for science) and their professional knowledge. The significance of this approach for teaching pre-service teachers is that establishing close and supportive working relationships with pre-service teachers and their lecturer, and strengthening peer interrelationships, could lead to positive outcomes for new teachers.

Further support for this approach comes from Wideen, Mayersmith, and Moon’s (1998) review that concluded that students benefit from working in groups in a close association with their teachers. As Wideen et al. (1998) point out:

In those studies where the candidates were supported by programme, peers, and classroom situations, and where deliberate exploration and reflection were encouraged, we saw the flowering of empowered teachers. These were beginning teachers who were not afraid to experiment, struggle and make mistakes — teachers whose transcripts expressed a sense of joy at their emerging understanding of what it is to be a teacher. (pp. 159-160)

Thus, it appears that an emphasis on improving pre-service teachers’ self-confidence and scheduling time for them to reflect individually and collegially should be important features of teacher education programs. They challenged science teacher educators to construct emotionally safe spaces in which pre-service teachers can
systematically identify their attitudes, beliefs, and emotions; take risks; and create alternative ways of seeing science and science teaching practice.

Zembylas and Barker (2002a) identified that an important goal of science teacher education should be to support pre-service teachers in identifying their emotions and attitudes about science and science teaching and learn how to develop emotional understanding of what they do. This is important in countries including Bhutan where there is a critical shortage of science teachers. One contributing factor to this shortage is teacher attrition caused by the emotional burnout and stress experienced by beginning teachers (Troman & Woods, 2000). This study highlights the significance of teachers’ emotions and attitudes in the process of becoming and being a teacher.

Di Martino and Sabena (2011) investigated how pre-service elementary teachers’ school mathematics experience affected their emotions towards mathematics and teaching because the authors recognised a link between fear and anxiety of children towards mathematics and how it is taught in schools. Students’ negative disposition to the subject also affects science subjects as it has mathematics components which are a major cause of concern for science students. This is consistent with the findings of Ernest (1991) who reasoned that mathematics is the mode of communication in science. Di Martino and Sabena administered open questionnaires to 167 pre-service elementary teachers. The major outcomes included: negative emotions towards mathematics prevail over positive emotions among pre-service teachers particularly fear and anxiety, pre-service teachers’ negative past experience with mathematics may condition their role as future mathematics teachers in a negative way, and students’ negative emotions of having to teach mathematics are linked to students’ self-efficacy beliefs towards mathematics teaching. This recent study was important because, pre-service teachers’ negative experience with school mathematics and science leads to their low self-
efficacy in these specialist subjects (Di Martino & Sabena, 2011). This study confirmed mathematics and teaching of mathematics as a matter of concern for students. Students’ negative disposition to the subject is also evident among Bhutanese students in general. Most students in Bhutan find mathematics difficult. Their lack of ability in mathematics hinders success in science. There were incidences in Bhutan where students forgo science courses in higher degrees either because of their negative attitude to mathematics or they fail to qualify for the science programs as their admittance to higher science studies hinges on mathematics marks. It is not surprising to notice that the country faces acute shortage of human resource in the field of science including science and mathematics teachers. However, Di Martino and Sabena’s study was not comprehensive because the interactions and expressions of participants were not video-recorded. Furthermore, the study focused only on fear and anxiety of mathematics.

Ripski, LoCasale-Crouch and Decker (2011) sought to determine pre-service teachers’ dispositions and emotions while participating in a traditional teacher education program. All students enrolled in a teacher preparation program in a mid-Atlantic university were invited to participate, of which 67 pre-service teachers (90%) consented to complete a survey. Two major outcomes of this survey study were that pre-service teachers reported lower levels of anxiety, depression and stress compared to others of their age, and pre-service teachers’ emotions appeared to remain stable during their teacher education program.

These findings offer a new understanding of the importance of gauging pre-service teachers’ emotions. Overall, pre-service teachers in Ripski et al.’s (2011) study reported positive emotions. This apparent self-selection of emotionally healthy individuals is promising for the profession. However, because the pre-service teachers’ emotions were measured exclusively from self-reported data in their study little is
known about their in-class experiences as they were experienced in the moment (Ripski et al., 2011).

Studies have also found a relationship between the pedagogical styles adopted by the teachers and the emotional state of students (Trigwell, 2012; Wittman, 2011). For instance, a survey of Swedish and German pre-service teachers to find the relationship between emotions and the prevailing learning methods in their institutions reported that positive emotions were related to student-centred learning pedagogy (Wittman, 2011). Similarly, university professors report positive emotions when they adopt student-centred approaches and negative emotions while engaging in transmissive pedagogies (Trigwell, 2012).

These findings suggest that the pre-service teachers’ disposition towards science and their emotional state are related to the classroom pedagogies and teacher effectiveness in the classroom as measured by the quality of their interactions with students. Understanding which of these pedagogies and teacher practices are relevant for the development of positive dispositions to teaching science is vital given that teacher preparation program provide a critical professional development platform influencing practice.

There were very few studies conducted on the EC of pre-service science teachers’ class especially with secondary pre-service science teachers. The previous studies discussed were all related to elementary pre-service teachers. Bellocchi et al.’s (2013) study of a pre-service secondary science-teacher education class was the first study on the EC and the only study to measure student perceptions of EC in the moment. Their study became a model for my study. It investigated the EC and quality of interactions using keypads or clickers at three-minute intervals during debates and post-debate discussions. The pre-service teachers rated the debate proceedings on the 5-point scale.
The debate proceedings were also video recorded. Detailed field notes were maintained during and after the debates to supplement the data obtained from clickers. Student ratings of EC were then averaged using Turning Point™ software installed on a laptop that received the incoming signals from the keypads as the students clicked their EC ratings. The average EC represented the emotional state of the group.

The class average for each interval was graphically represented for each lesson and each graph for each lesson was reviewed to identify those intervals that pointed well above neutral and those intervals that dipped below neutral. The relevant video segments were identified using these peaks and troughs for analysis of both verbal and non-verbal conduct. Relevant audio files (aiff) were extracted from video data and analysed using PRAAT software for such speech parameters as pitch, energy intensity in air, formant frequencies, bandwidth, and speech rate. Intensity of energy in air was used for the purpose of ascertaining levels of collective effervescence and emotions in the study. Interactions between students and their tutor in these segments were transcribed and analysed at the micro level using conventions aligned with conversation analysis (see Roth & Hsu, 2010).

Findings from Bellocchi et al.’s (2013) study include; events such as engaging debates and informal talk led to positive EC whereas flat debates and formal talk produced low EC. An engaging debate was described as one where interactions and rebuttals were associated with eye contact, expressive gestures and speech, and the use of humour. In flat debate presentations the speakers read notes and there was an absence of humour with limited eye contact. Casual talk and talk on personal matters such as how they spent their term break were considered more positive than formal talk such as briefing about the debates and other housekeeping issues.
Bellocchi et al.’s (2013) study offered a way forward for my study as they were successful in capturing pre-service teachers’ perceptions of the moment-by-moment variations in the classroom EC. One limitation of their study was that the study was conducted in the first author’s class so his presence may have influenced students’ behaviour in the class or their ratings of the class EC. I extended and refined the work of Bellocchi and his colleagues in my study in a different cultural context.

3.8 ISSUES OF RELEVANCE TO MY STUDY

From this literature review, a plethora of issues surfaced that have significance for my study. Of particular interest is the need for teacher educators to transform their pedagogical practices through teacher reflection in order to improve their class EC.

3.8.1 Teacher as reflective practitioner

According to Tinning (2002), critical reflection encourages educators “to develop the skills of considering the teaching process thoughtfully, analytically, and objectively as a way of improving classroom practices” (p. 23). Furthermore, it makes teaching more productive and satisfying, thereby freeing teachers from the burden of a routine job, and helping them “to avoid burnout” (Farrell, 2004, p. 2).

Reflective practice is a key component of effective teaching and professional growth (Ferraro, 2000). It comprises a deliberate act of reviewing and critically thinking about practice with the idea of increasing learning opportunities for students and teachers (Wills, 2002). Reflective practice can lead to self-initiated change; through collaborative processes teachers can engage in reflective dialogue about classroom practice or student performance thereby promoting a shared focus and negotiated understanding within a school.

Current ideas of the reflective practitioner owe much to the work of Schön (1987). He emphasised an interactive relationship between theory and practice which he saw
embodied by experienced practitioners. Dewey (1933), however, is generally acknowledged as the first educationalist to recognise and promote the value of reflection as a means of learning from experience. He promoted the necessity of learners being involved in doing but then in thinking about what arises from their doing. In this way meaningful and creative learning can result. For Dewey, it was reflective thought that “converts action that is merely appetitive, blind and impulsive into intelligent action” (p.17). It is such “intelligent action” that we wish our pre-service science graduates to achieve in Bhutan.

According to Schön (1987), teacher reflection exists in two forms; reflection in-action and reflection on-action. The former reflection (in-action) refers to reflective practices that occur in the moment, when teaching and learning is happening. Reflection on-action is a delayed thinking process that can transform teacher practice. It is reflection on-action that is of significance for my research.

The process of reflecting on emotions can contribute to the reproduction of positive emotions and successful interactions and learning experiences in the classroom (Zembylas & Barker, 2002a). Zembylas and Barker reported that the participants in their study indicated that undertaking the study was beneficial to their teaching practice. The processes of reflection embedded in the study programs encouraged teachers to understand their emotional arousal in relation to science and their interactions with students. Zembylas and Barker argued that understanding and reflecting upon emotional experiences, either positive or negative, allowed them to work towards better pedagogy, students’ management skills and students’ academic outcomes.

Reflection that can transform thinking and practice requires deliberate effort and the space and time for teachers to reflect. Teachers have several options to stimulate self-reflection. They could administer questionnaires, maintain a journal, or record and
review audio or video recordings of their classroom practices (Richards & Lockhart, 1994). Video recording is arguably one of the most efficient tools for reflection since it provides an objective source that can be viewed repeatedly to examine different features of classroom practices.

The benefits of video recorded lessons include:

i. helps teachers notice and respond to both strengths and weaknesses about their teaching (Orlova, 2009);

ii. allows teachers to view the lesson immediately and re-examine it (Orlova, 2009); and

iii. has a well-known motivating effect (Maclean & White, 2007).

Reviewing episodes from video recordings allows teachers to reflect on the interactions that may otherwise be ignored and make informed transformations to the teaching.

3.8.2 Pedagogy in the science classroom

Generally, students find science interesting and engaging at the primary level, but when students progress to secondary level their interest towards science wanes (Jenkins & Nelson, 2005; Rinchen, 2001) and they develop preference for non-science subjects (Rinchen, 2001; Sjoberg & Schreiner, 2005). The review of literature shows their disinterest in science subjects results from the difficult nature of science subjects and lack of role models in scientific professions in the country (Rinchen, 2001); quality of instruction in the classroom (Osborne, 2003); and teacher “directed pedagogy” (Gale Seiler & Gonsalves, 2010).

Atwater and Wiggins (1995) argued that although a majority of African American students have positive attitudes toward scientific careers, only a quarter of them hold favourable attitudes toward classroom science. Other researchers attribute African
American students' low achievement in school science, and their alienation from school to inappropriate teaching strategies prevailing in the science classroom (Teel, Debruin-Parecki, & Covington, 1998).

In contrast, a study conducted in Australia contends that students develop more positive attitudes towards their subjects, when the teacher was perceived to be highly supportive, equitable, and involves them in investigations (Rawnsley & Fisher, 1998). It was also noted in Singapore and Australia that students scored well when they perceived the environment as more student friendly. Students’ self-esteem and attitudes were more favourable in classrooms perceived as having more teacher support, task orientation and equity (Khine & Fisher, 2001).

In Taiwan, the most important element of being a good teacher was having good content knowledge. Yet, in Australia, having a good interpersonal relationship between the teacher and students was considered the most important element in the education process (Khine & Fisher, 2001). Teachers in China stress clarity in explaining and showing enthusiasm in their teaching as the highest priority, but teachers in America felt that sensitivity and patience are the most important attributes of a good teacher (Khine & Fisher, 2001).

How students learn greatly impacts what they learn, and students learn best when engaged in inquiry, small-group work in the classroom (Bransford, Brown, & Cocking, 2000; Springer, Stanne, & Donovan, 1999). As reported by the American Association for the Advancement of Science [AAAS] (1998):

> the collaborative nature of scientific and technological work should be strongly reinforced by frequent group activity in the classroom. Scientists and engineers work mostly in groups and less often as isolated investigators. Similarly, students should gain experience sharing responsibility for learning with each other. (p. 148)
Inquiry science may be a useful alternative approach to the teacher-dominated pedagogy for several reasons: Inquiry approaches can foster development of in-depth subject knowledge in students; facilitates the growth of students’ problem solving abilities by provoking their thoughts; and acknowledges students’ prior knowledge and facilitates their understanding in science through effective guidance and modelling (Bransford et al., 2000). Small-group learning leads to greater self-esteem among college students. It also leads to more favourable attitudes toward learning the material (Springer et al., 1999).

Developing favourable attitudes toward science has often been considered as one of the important goals of science teaching. Generally, educators have assumed that the availability of a myriad of pedagogies will enable teachers to vary classroom procedures, to avoid monotony, and to arouse interest and attention in the students. For instance, Hofstein, Levy, Nahum, and Shore (2001) found, that a well developed laboratory activities have potential to enhance students’ conceptual understanding as well as their positive attitudes toward science and cognitive growth. Similarly, a study by Prokov, Tunce, & Kvasničáč (2007) found a day of field trip has not only increased the attitudes of 11-12 years Slovakian students’ attitudes toward biology but the students displayed a better understanding of concepts like eco-system and food web.

The laboratory work provides a unique medium for teaching and learning in science education, and science educators have suggested that rich benefits in learning accrued from its use. The history of laboratory work entails that laboratory activities were mainly used to confirm and illustrate information gleaned from the teacher or the textbook until the launch of new science curricula in the 1960s. This change has resulted in shifts from tradition in the role of laboratory work as posited by Shulman and Tamir (1973) that in "the new curricula which stress the processes of science and
emphasise the development of higher cognitive skills, the laboratory acquired a central role, not just as a place for demonstration and confirmation, but as the core of the science learning process” (p. 1119).

Bhutan’s first science education program was based on the Indian curriculum. The general public perceived that the standard of school science curriculum was not adequate to prepare students for the world of work. Bhutanese students’ resistance to science is attributed to curriculum, resource constraints, English as the medium of instruction, the difficult nature of science subjects, and lack of role model in scientific areas.

Bhutanese schools continue to rely on textbooks written for other countries or written by outsiders. The science curricula for secondary classes were content heavy which left limited time for practical classes. Whatever little practical work they did was done to confirm the existing theory only. Lack of laboratory equipment, technical support, and teacher expertise were attributed to discouraging adequate practical lessons (Fahmi, 2008). Fahmi argued most grade 12 science graduates lacked basic knowledge and practical skills and these least qualified and motivated science graduates chose to become teachers.

The medium of communication in Bhutanese schools is English with some use of the national language Dzongkha. The medium of instruction has an adverse effect on the students’ performance in science as English is the second or third language to most Bhutanese. According to Wangmo (1995), in Bhutan, students’ achievement in science is affected by their proficiency in English. Most students have difficulty in understanding the test questions and expressing answers. Therefore, prior to any examination, students are given an additional 15 minutes to read questions and instructions before they begin to write (Tshering, 1998). The shortcomings of any
Science text are mostly in the language. As Dzongkha has limited vocabulary, there is no substitute word in Dzongkha for some scientific terms. For instance, *evaporate* in science is translated as *dry up* in Dzongkha. The words *mass* and *weight* are the same in Dzongkha (Tshering, 1998).

Although knowledge of science content and availability of resources may affect teachers’ confidence in teaching and influence their choice of pedagogy, it is the pedagogy that can affect students’ attitudes toward science. Therefore, the changes in the pedagogy argued here are of great educational importance for the rigour and relevance of science education, and the struggle to provide conditions to generate successful interactions and positive EC is therefore a responsibility that falls on us all as science educators.

### 3.9 SUMMARY OF LITERATURE REVIEW

The Royal Government of Bhutan has high expectations of teachers as is evident in this statement:

> The attainment of the set goals will be dependent upon our capacity to train teachers who are not only highly professional in their approach to education but also motivated and dedicated to the profession they have chosen (RGOB, 1999, p. 53).

Bhutan needs an educated citizenry to steer the country forward. To produce a high quality workforce, high quality teachers and programs, especially in science education, are required.

The review of related literature suggests that science in schools is taught like any other subject with little importance on its practical applications (Fensham, 1985), this is further aggravated by the lack of science resources, non-science teachers teaching science and a lack of teacher expertise (Fahmi, 2008). Under these circumstances
teachers are bound to be apprehensive and it would be reasonable to imagine that high teacher anxiety would translate into poor quality instruction. The students’ feelings toward science courses, students’ achievement in science and their future career choices were correlated with their attitude toward science (Rodrigues, Jindal-Snape, & Snape, 2011). For instance, Turkish students’ negative attitude toward science was viewed as a potential barrier to comprehending the learning of science (Jelinkek cited in Turkmen, 2013). If Bhutan or any country wants to produce quality science teachers which would bring positive impact to the system, the start of the process for producing high quality science teachers must begin in the science classrooms at the colleges of education.

The literature also suggests that teachers should be aware of their emotional experiences which are vital for the kind of relationship that is built between teacher and students which in turn is the essence of the classroom EC. If the teachers are aware of their emotional experiences they may be positioned better to transform the teaching and learning of science. One way for the teachers to be aware of their emotional experiences is by being a reflective practitioner. The process of reflecting on emotions can contribute to the reproduction of positive emotions and encourage teachers to understand their emotional arousal in relation to science and their interactions with students (Zembylas & Barker, 2002a).

While previous research has shown that teachers do experience positive and negative emotions in teaching (Zhang & Zhu, 2008) there is little evidence from these studies on the ways that the emotional experience may relate to the EC of the class. The research contexts on emotions and EC in science and general education research deliberated in this section have focused mostly on the experiences of beginning teachers and less on the pre-service science teachers and that too with primary teachers.
Moreover, there is scant information about students’ perceptions of EC in their pre-service science teacher education classes.

Most studies of teacher emotions employ interviews (Cross & Hong, 2009; Day & Lee, 2011). Although interview studies enable the understanding of the emotional lives of teachers (Day, 2011), emotional experiences are fleeting and may not be recalled during interviews. Therefore, to elicit comprehensive understanding of the events that prompt emotional states requires more subtle methods than interview (Ritchie et al., 2011).

As Ritchie et al. (2011) acknowledged that Zembylas (2004b, 2005b) made a shift from interview studies towards ethnographic work employing multiple methods that encompassed classroom observations, and analysis of classroom artefacts, teacher emotion diary, along with interviews. Despite these multiple data sources, he did not report on the analysis of teacher-students interactions on a micro level, a very important source of emotional experiences. Zembylas (2011) also encouraged prospective researchers on teacher emotions to accentuate on theoretical discussion and employ multiple methods to illustrate emotional experiences better.

The limitations identified in Zembylas’s (2004b, 2005b, 2011) study was addressed in the case study of a beginning science teacher (i.e., Ritchie et al., 2011; Tobin et al., 2013). Both studies focussed on the details of the micro-processes of successful and unsuccessful interactions that produced emotional arousal in the teacher and her students in the class. Tobin et al.’s (2013) study focused on the relationship between valence of EC and the types of interactions that unfolded in the class (i.e., what type of interaction generated positively valenced EC or negatively valenced EC). However, in Tobin et al.’s study the EC of the class was rated by a team of experts following the class and not the students’ perceptions of classroom EC. Similarly, in
Ritchie et al.’s (2011) study coding of the video-recorded lessons were done by the science teacher retrospectively rather than in the moment.

Bellocchi et al. (2013) undertook a study of EC in a class for pre-service secondary science teachers that recorded students’ in the moment perceptions of EC. In that study, positively valenced EC was associated with natural rituals and engaging debates whereas the EC was negatively valenced during formal rituals and flat debates. However, since the study was conducted in the first author’s class his presence may have influenced students’ perceptions of the classroom EC. Furthermore, all the studies related to emotions and EC of teachers and pre-service teachers science class discussed in this section were conducted in Western contexts. My study seeks to capture the details of micro-processes of successful and unsuccessful interactions that are associated with positive EC and negative EC to extend current understandings of emotions in the RUB science class by employing multiple methods of data collection and data analysis.

The literature presented in this chapter also includes a review of the article by Metiu and Rothbard (2012). The article details how the key elements such as the assigned task (group project), use of artefacts (computer, codes, software, white board, and marker), and common emotions experienced by members working together generated mutual focus of attention that led to the accomplishment of a project. However, group engagement and mutual focus of attention among members were facilitated by several enabling conditions such as individual engagement, compelling direction, frequency of interaction, and informal interactions. This article informs the current study that members of any organisation need to engage in interactions in order to develop mutual focus of attention on a given task. For instance, successful interactions among members can generate knowledge and insights to achieve a
breakthrough but they must be provided with resources and compelling direction to achieve a task.

The following chapter (Chapter 4) presents the research design and methodology of the study.
Chapter 4: RESEARCH DESIGN AND METHODS

4.1 INTRODUCTION

I chose to study the nature of pre-service teachers’ science classroom emotional climate (EC) because studying pre-service teachers and the conditions of science teaching where higher levels of emotional understanding are being achieved can give valuable insights and clues to reform science teaching.

The following questions fine-tuned by the literature review helped address the nature of pre-service teachers’ science education class EC:

1. What affects the emotional climate in a science classroom for pre-service teachers?

2. How do pre-service teachers respond to classroom interventions to improve the emotional climate of a science class?

Section 4.2 of this chapter outlines the interpretive approach adopted in my study of EC in a science classroom for pre-service secondary science teachers in Bhutan. Section 4.3 justifies the selection of a case study design. The research setting and sampling is identified in Section 4.4 followed by a description of data sources and research plan in Section 4.5. The procedures for data analysis are explained in Section 4.6. The criteria for quality of the research are outlined in Section 4.7. Section 4.8 addresses ethical issues. The final section (Section 4.9) of this chapter provides a summary.
4.2 INTERPRETIVE RESEARCH APPROACH

The study of the EC of pre-service teachers in Bhutan draws on multiple methods that are designed to generate rich data analysed from an interpretivist stance. In interpretive studies the researcher sets out with the belief that access to reality is only possible through social constructions mediated by language, consciousness and shared meanings (Erickson, 1986). Interpretive studies usually attempt to understand phenomena through the meanings that people bring to the forefront and "aims at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (Walsham, 1993, p. 4–5).

Interpretive research and Erickson’s (1986) ideas are based on the grounds that Oliver (2012) posed for symbolic interactionism. First, human beings act upon the world on the basis of the meanings that the world has for them. Second, the meaning of the world is socially constructed through one’s interactions with members of the community. There is not one universal truth. There are multiple truths derived from the local communities and have particular local meanings to the members of that community (Erickson, 1986). An interpretive researcher can never get to the one “truth” and obtain a complete understanding of the setting he/she is studying. Third, the meaning of the world is processed through interpretation.

Interpretive research is appropriate when one wants to find out more about certain structures of experience, the meaning-perspectives of the research participants, and specific interrelationships between participants and environment. Interpretive research attempts to understand the process within a given context, and the temporal relationships of events and participants. One of the major goals of interpretive research, in Erickson’s (1986) words, is “to discover the specific ways in which local and non-
local forms of social organisation and culture relate to the activities of specific persons in making choices and conducting social action together” (p. 129).

This approach seeks to understand reality from the insiders’ points of view and contexts in order to understand the significance of differences in them (Bergstrom, 2000). Interpretive researchers use inductive methods to collect data by exploring issues/questions, which develop and change as the research proceeds. They characteristically use interviews and observations, and review documents to gather data (Cresswell, 2003). Thus, as stated by Smith and Heshusius (1986), interpretive research pursues the understanding of values, beliefs and meanings of social phenomena, thereby obtaining a deep and sympathetic understanding of human cultural activities and experiences. According to Guba and Lincoln (1994), from an interpretive standpoint, what distinguishes human (social) action from physical objects is that the former is inherently meaningful.

On the question of how we know reality, the interpretive perspective takes the position that results are tentative and focus on collective meaning-making as they are interdependent with the research participants (Bergstrom, 2000). Knowledge will be produced based on the findings that have been created in the process of interaction between the researcher and the researched (Guba, 1990). The purpose of the research is to build understanding that is more sophisticated than previous understandings by meaningful social action in natural settings (Neuman, 1997). In interpretive research it is the researcher’s job to unravel the multiple layers of meanings represented by human action. One can only achieve an understanding of the situation by closely attending to and documenting the particulars of the given setting (Erickson, 1986).
4.3 RESEARCH DESIGN

This study adopted an ethnographic case study design (Simmons, 2009) to investigate the EC of the B.Ed pre-service secondary science teachers’ classroom as used in similar research in science education (Ritchie et al., 2011).

4.3.1 Ethnographic Case Study

The research approach was a case study because Pelmo (tutor) and her students’ classroom emotional transactions were the phenomena under examination rather than the college or their classroom in general and it was ethnographic because the students with whom Pelmo interacted and the college form vital components of the culture and context in which the transactions took place (Ritchie et al., 2011).

Case studies are often used in educational settings to study pedagogy and teacher practices (Roth, 2007). Case studies generally employ interviews but additional relevant documents, media supplements, and field notes often accompany cases. Case study is a commitment to examine a situation or phenomenon in its ‘real life’ context, to understand complexity, and to describe case study by methods other than quantitative or qualitative (Merriam, 1998; Stake, 2005; Yin, 2009). Simmons (2009) extends it further by including a purpose and research focus:

Case study is an in-depth exploration from multiple perspectives of the complexities and uniqueness of a particular project, policy, institution, programme or system in a real life context. It is research-based, inclusive of different methods and is evidence-led. The primary purpose is to generate in-depth understanding of a specific topic, programme, policy, institution or system to generate knowledge and inform policy development, professional practice, and community action. (p. 21)

In other words, there is not a ‘single objective reality’ but rather reality is construed through social interpretation. The researcher sets out with the belief that access to reality
is obtained only through social constructions mediated by language, awareness, and shared meanings (Erickson, 1986). Simmons’s (2009) notion of case study research (i.e., knowledge or reality is socially constructed) aligns closely with Erickson’s (1986) interpretive perspective which has been adopted in this study.

The advantages of case studies are their applicability to real-life, contemporary human situations, and their public accessibility through reports. Case study results relate directly to the common reader’s everyday experience and facilitate an understanding of complex real-life situations (Stake, 2005). Conversely the involvement of multiple data sources makes case studies complex.

4.3.2 Ethnographic Procedures

This study explored the EC of a pre-service teachers’ science education classroom. This can be best studied adopting ethnographic procedures as the data helped me to understand pre-service teachers' needs, experiences, viewpoints, and goals. Such information enabled the teacher to design useful and worthwhile intervention programs for teachers and ultimately to improve student learning.

I took an ethnographic approach to research the EC of a B.Ed science education class as it provided a method for learning about, and learning how to talk about, classroom cultures by placing the researcher in the research (Simmons, 2009). I was inevitably part of the research context that I was investigating, as I needed to be in the classroom in order to “capture” the experiences of students and their tutor.

Ethnography in its simplest form is just writing about cultures (Spradley, 1979). A popular definition of ethnography is found in Hammersley and Atkinson (1995), who write of ethnography as:

referring primarily to a particular method or sets of methods. In its most characteristic form it involves the ethnographer participating, overtly or
covertly, in people's lives for an extended period of time, watching what happens; listening to what is said, asking questions – in fact, collecting whatever data are available to throw light on the issues that are the focus of the research. (p. 1)

The above definition is apt to my study as I spent five months with my research participants; observing, talking, and listening to them. In a way, I created a descriptive account of social life and culture in a particular social system based on detailed observations of pre-service teachers and their tutor actually doing and behaving in the classroom (see Johnson, 2000). The next section details how the research was set in the Case College and the characteristics of the case class.

4.4 RESEARCH SETTING

The purposeful sampling strategy has been employed to elicit rich and in-depth information of a typical case (Creswell, 2008; Patton, 2001). The research site was chosen through a purposeful selection of Case College of Education (CCE) at the Royal University of Bhutan (RUB). The participants for my research were 28 B.Ed II (e.g., II refers to second year) secondary science pre-service teachers (majoring in Physics and Maths) taught by Ms. Pelmo of Bhutanese origin, their science tutor. It was a mixed gender (10 females and 18 males) class in the age group of 20–23 years. This class was selected (i.e. purposefully selected) because other cohorts of B.Ed were either new to the college or engaged in other activities. For instance, B.Ed I pre-service teachers were new to the system as they have just joined the college, B.Ed III had left for field practicum and the final year (B.Ed IV) were busy preparing for their civil service selection test.

These students demonstrated a range of academic achievement. Moreover, these students had completed one module of Physics Education (Physics Education I) in their previous semester. Owing to the diversity of students and their prior experiences with
the Physics Education I module in the previous semester, Ms Pelmo and I were confident that this group would provide a rich case for the study.

As posited by Patton (1990) this sampling provided rich information which is necessary for a case study:

The logic and power of purposeful sampling lies in selecting information-rich cases for study in-depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research. (p.169)

Ms. Pelmo has a master’s degree in Physics. I have known her since 2001. On a number of occasions we have co-taught professional modules to pre-service teachers and resourced workshops for college faculty and school teachers. This makes her class suitable for the study because the use of cogen was more likely to be accepted as a legitimate practice due to my previous collaborations with Pelmo. Ms. Pelmo was enthusiastic about use of new technologies such as audience response technology to rate class EC and software to study speech parameters in the study.

The current study was conducted in Physics Education II module. For this module Pelmo was allotted two lecture classes of one-hour duration each and a block period of two hours for practical laboratory activities. Her class activities ranged from lectures, group discussions, and presentation by students. Practical laboratory activities were conducted once a week. This pattern of instruction with lectures followed by discussion and student presentations became a ritual that was followed throughout the semester.

Once everybody was settled, typically the class commenced with Pelmo asking questions of the students or brainstorming about the topic of the lesson with students. Brainstorming helped Pelmo to connect her lesson with students’ prior knowledge. Such instructional approaches not only helped her connect theory to practice (Korthagen &
Kessels, 1999) but motivated students as well. At times Pelmo also initiated 2-3 minutes of meditation for students to refresh and gain focus before the start of the class.

The study was conducted during spring semester over a five-month period from early February till late June 2012. During the research period 23 lessons were observed and video recorded. EC was recorded for 16 lessons using audience response technology. The technology consisted of numbered devices, and a total of seven cogenerative dialogues (cogens) were conducted with selected students. All 28 pre-service teachers and their tutor were interviewed once and the researcher maintained detailed notes of the proceedings of the class at the end of every lesson or set of interactions with pre-service teachers and their tutor to supplement the findings from other data sources. This writing included a catalogue of daily life, along with a discussion of rituals, phenomena, and an assortment of other events.

4.5 DATA SOURCES AND RESEARCH PLAN

This ethnographic case study aimed to study EC of a pre-service teachers’ science education class in the CCE at RUB. This was necessitated considering the need to improve the standard of science education in the country by providing insights into the lived experiences of pre-service secondary science teachers and recommending strategies for the betterment of the teaching profession.

Since the study deals with emotions and EC of pre-service teachers science class utmost care was taken to get a comprehensive coverage of the classroom proceedings. The data sources include students’ perceptions of the class EC using the audience response device called clickers. This data source was supplemented by other sources such as video recording – that captured classroom proceedings and the kind of interactions that the tutor and students engaged in such as facial expressions, body gestures, and verbal emotive expression. Cogen helped unravel class interactions that
produced positive EC and collegially recommended strategies to improve practices that were deleterious to the class. The student interviews and tutor’s stimulated recall interviews are used to achieve further insights into the verbal and non-verbal interactions between the participants. The researcher diary with a chronological account of classroom interactions helped validate information from other data sources.

This study accessed multiple data sources to develop rich understandings about the pre-service teachers’ and their tutor’s experiences of their classroom. These data sources included classroom EC (clickers), video recordings, cogens, interviews with students, stimulated recall interview of the tutor, and the researcher diary. The data sources were accessed over a five-month period. Data interpretation was ongoing which led to the construction of a set of assertions by the end of the study. The overview of the research plan is given in Figure 4.1 followed by detailed explanation of each data source.

<table>
<thead>
<tr>
<th>Study</th>
<th>Tools</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case study</td>
<td>Emotional Climate (Clickers)</td>
<td>16 video recordings with clickers</td>
</tr>
<tr>
<td></td>
<td>Video recordings</td>
<td>23 video recordings</td>
</tr>
<tr>
<td></td>
<td>Researcher diary</td>
<td>throughout the study</td>
</tr>
<tr>
<td></td>
<td>Cogen</td>
<td>7 cogens</td>
</tr>
<tr>
<td></td>
<td>Interview</td>
<td>All pre-service teachers were interviewed once</td>
</tr>
<tr>
<td></td>
<td>Stimulated Recall Interview</td>
<td>1 Stimulated Recall Interview with the tutor</td>
</tr>
</tbody>
</table>

*Figure 4.1. An overview of the research design and plan.*

### 4.5.1 Student Perceptions of Classroom Emotional Climate

The primary source of data was pre-service teachers’ perceptions of the EC of their science class. Students were asked to record their perceptions of EC for each lesson at three-minute intervals using Turning Point™ keypads (clickers). Intervals refer to lesson segments of three minutes duration prior to the students’ rating of the class EC. Pre-service teachers were informed that EC represented the emotional state of
the group rather than their individual feelings. The keypads enabled students to record their perceptions every three minutes in an attempt to measure the moment-by-moment changes in EC using a five-point Likert scale: 5-very positive; 4-positive; 3-neutral; 2-negative; and 1-very negative. The rating of 5 and 4 conforms to positive EC valences and rating of 2 and 1 conforms to negative EC valences (Bellocchi et al., 2013). This involved pre-service teachers rating the previous three minutes of the lesson by clicking on one of the five numbered options listed above. These were recorded by the software from which I manipulated the data subsequently to determine the average perceptions of EC for each interval. Within-lesson averages for each three-minute interval were used to identify events that were either positive or negative in EC.

I indicated the start and end of the three-minute intervals by holding up a white paper or by making a coughing sound. The sound was useful as an indicator when the students were engrossed in discussions. Video recordings of classroom interactions were made using two Sony video cameras. One camera was mobile and it captured the movements of the tutor while the other camera was fixed on a stand and was focused on the students approximately one metre away from the closest student. The mobile camera was operated by one of the senior students from other B.Ed cohorts.

The researcher was rarely a participant except for waving A4 white paper indicating students to record their perception of EC using clickers and occasional movement to guide the cameramen besides maintaining diary records of the classroom interactions. The students were not disrupted as they did not pay any attention to the researcher who was sitting at one corner of the class.

The use of clickers to measure EC of the class poses certain limitations because it will be difficult for students to attend to class activities and rate class EC simultaneously. To reduce the impact of this limitation, the EC data were employed
heuristically to identify class events from video data rather than taking the EC ratings to be direct measures of “the class EC” as if the measure were isomorphic to some external reality (Bellocchi et al., 2013, p.549).

### 4.5.2 Video Recording

A growing number of researchers and teachers in science education have found the benefits of capturing and evaluating classroom activity through the use of videotape (Elmesky, 2003). Digital technologies are becoming more commonly used in all areas of educational research. In particular, as they become more user-friendly, many technologies are now being used as tools in research. The ease of use of digital video and the accompanying editing facilities help researchers to readily use this technology with minimal specific expertise in the area. The rich and visually appealing nature of video-based data can convey a strong sense of direct experience of the phenomenon being studied (Dufon, 2002; Pea, 1999). In my study video recordings help capture the conscious and unconscious acts of pre-service teachers and their tutor in natural settings including non-verbal cues. Video became a powerful tool in that it provided a springboard for discussion during cogen and as a source of reference for changing classroom activities and structures (cf. LaVan, 2004). The video recording provided further insight into the verbal and non-verbal interactions between the participants.

There are a number of advantages to video recording in ethnographic research. Video recording provides the researcher with denser information (Plowman, 1999) and more contextual data than other data sources (Iino, 1999). Video recording not only enables researchers to accurately identify the speakers, but also provides information about non-verbal behavior such as posture, gestures, facial expressions, and proxemics, which help identify the kind of emotions that they are experiencing. Another advantage of video recording is durability (Grimshaw, 1982), allowing the researchers to refer an
event repeatedly (Iino, 1999). Replaying the event gives more time to contemplate and deliberate before drawing any premature conclusions.

Some of the shortcomings of video recording are that it can capture only what is observable within the range of the camera thereby missing the unspoken thoughts and feelings of the participants (Fetterman, 1998). This limitation can be overcome to some extent by using multiple cameras and recording the event simultaneously. In my study two video cameras were used. One camera was mounted on tripod focusing on students and the other was mobile following the teacher. Other shortcomings include the video file getting corrupted owing to lack of skills in handling a camera.

4.5.3 Researcher Diary

In order to supplement findings from the other data sources a diary was maintained by the researcher. The diary proved to be a very important source of information as it contained details of my experiences and perceptions of what happened in the classroom and how it happened.

Diary is one of the forms of research writing that has received little attention though it is central to the research process, especially for those conducting qualitative research studies (Newbury, 2001). The research diary is different from academic paper writing in at least two ways. First, it does not attempt to present the process of research in the linear fashion that is typical of research paper writing, what Kaplan calls "the reconstructed logic of science" (Marshall & Rossman 1995, p.15). Instead it captures something of "the real inner drama" of research "with its intuitive base, its halting time-line, and its extensive recycling of concepts and perspectives" (Bargar & Duncan, 1982, p.2), an aspect often concealed from view in the final published accounts. Second, its purpose is not primarily about the communication of the research to others, but to facilitate the research process through recording observations, thoughts and questions as
they happen, to be used by the researcher later, and to stimulate reflective thinking about the research.

There are no rules as to how research diaries should be compiled, the prime consideration is finding a format and style that fits with the needs of the research project, and which is found to be workable and useful by the researcher. As Burgess (1981) notes “while [sic] researchers indicate that part of their research activities involves keeping diaries, they do not tell us, in any detail, about how these diaries may be established and maintained” (p.75).

As advised by Burgess (1981) I used a researcher diary to record a chronological account of events that unfolded during classroom interactions including a catalogue of teacher’s entrance and exit times from the class, student absentees, and the topic and date of the lessons taught. These analytic accounts helped me in organising the data and concepts held by the participants that can be used in analysing the data from other sources. The diary was used to supplement salient features of video data and interviews. The diary was also used for on-going validation of the classroom interactions.

The strength of using diaries must be balanced against certain challenges. When the diary period gets prolonged the researcher gets tired of keeping records resulting in unclear or less thorough accounts (Marino, Minichiello, & Browne, 2004; Wiseman, Conteh, & Matovu, 2005). If the researcher tries to maintain diary accounts retrospectively then the data become subject to bias. In my study at times the diary entry was made retrospectively as I had to guide my cameraman in the class and also signal students to rate EC of the class at three-minute intervals. This practice has the potential risk of introducing error in recollection. Therefore, in my study the diary was used to supplement data from other sources such as video proceedings, interviews, and cogenerative dialogues.
4.5.4 Cogenerative Dialogue

The fourth source of data was generated through cogenerative dialogue (cogen) with selected pre-service teachers along with their science tutor (Pelmo). Emdin (2008) defines cogen as “conversations in which people come together and discuss a social field or place where they have had and will continue to have a shared experience” (p.774). Cogen was based on the understanding and philosophy that one needs to express and explain personal experiences through collective understanding and activity (Tobin, Seiler, & Walls, 1999). In my study, cogen was used as a platform to share opinions of pre-service teachers with their tutor in a combined effort to understand the events that unfolded in the classroom. These conversations can lead to insightful observations and classroom experiences. To the extent possible, the participants in cogen create a shared collective responsibility for future activity and the accomplishment of its outcomes (Tobin & Roth, 2006). The purpose of cogen was for participants to share and discuss their thoughts and opinions in a joint effort to understand the proceedings of the classroom. These conversations led to insights into the nature of the classroom because the pre-service teachers and their tutor discussed what they saw in the classroom, and the personal experiences of pre-service teachers (things often left unsaid or ignored) were brought to the foreground. Cogens evolved in response to the need to express different kinds of experiences and to explain them in and through collective interpretation, from which new possibilities for individual and collective actions emerged. These new possibilities can then be executed as the actions the participants decided on become available rather than accessible only in theory.

In cogen each description or explanation offered by one of the participants became a resource for others, who reacted to, acted on, or reinterpreted what was said. These actions and interpretations in turn became resources for other participants, both
offering new possibilities for interpretive comments and constraining what had been said. Because the participants in cogen are representatives of all stakeholders in the class, it was important to disseminate reports to others about what was agreed to in cogen. The students reported to their peers on what was discussed and agreed to in the smaller scale cogen dialogues. Video vignettes were used to project evidence of the patterns and contradictions from the class on the need to change.

As a research method, cogen provided interesting insights into many aspects of the social lives of the students, not only what was said, but also non-verbal interactions and into the emotional content of the interactions between students (Tobin & Roth, 2006).

A salient feature of the video data was discussed through regular conversations and cogen in which ideas on how to improve the quality of teaching and learning was considered. Cogen was conducted at regular intervals to identify contradictions and patterns of activity to be identified, and their relationships to be discussed (Roth & Tobin, 2002). In cogen there was considerable success in using video clips of lessons to show all participants their practices and to create catalysts for conversations on contradictions that arose from praxis (LaVan, 2004; Mousley, 1998).

Three student participants participated in each of the seven cogens as recommended by Tobin & Roth (2006). According to Tobin and Roth (2006), participants are selected so as to maintain diversity of students represented in the cogen. In order to maintain diversity of participants, samples included two male students (including one gregarious student) and a female student (quiet in nature) along with the tutor. Tobin and Roth (2006) posited that often the selection is constrained by the availability of participants because cogen was usually scheduled as soon as possible after the class when some students may have other engagements. In my study, all
cogens were scheduled after the class hours (4.30 p.m.–5.30 p.m.) so that their other engagements were not disrupted. Students were accessible at this time because most live on campus and it preceded the dinner scheduled for 8.00 p.m.

The researcher was also a part of cogenerative dialogue and the presence of researcher might bring certain subjectivity to the discussion. To minimise any biases I restricted my role to that of scheduling and chairing the cogen. My role as a chair includes identifying the participants and meeting room, scheduling the cogen session, and setting camera prior to the cogen. Each cogen commenced with the researcher introducing the rules to the members emphasising on the need to speak openly as no voice is privileged and cogen creates a shared space where the tutor and students can exchange dialogue openly though it was already explained in the bigger forum earlier. To avoid bringing any subjectivity to the discussion I have constructed guidelines to keep the discussion on track and focussed on the issues at hand. The guidelines include:

- What did you like/did not like about the particular class?
- Was there any act on the part of a tutor that put you in a disadvantaged position?
- Was there any act on the part of students that put you (tutor) in a disadvantaged position?
- What strategy you want to adopt to bring change in the classroom emotional climate in the subsequent lessons?

I also used video recorded vignettes of salient teaching episodes to generate discussions. The cogen session concluded with the follow up plan of action to be tried in the subsequent lessons cogenerated between the tutor and students.

The subsequent cogens commenced with the researcher confirming from the tutor and students that the follow up strategy cogenerated in the previous cogen brought any positive impact on the classroom EC.
Though cogenerative dialogue has many positive benefits, some of the drawbacks include that only the cogen participants receive the benefit of prolonged engagement with the researcher and their tutor. Such practice can be viewed as the researcher and tutor facilitating trust and collective responsibility among cogen participants and depriving non-participants from its benefits (Anderson, 1998). This could lead to a preferential treatment of the cogen participants leading to a risk of developing hostility and estranged feelings between cogen participants and others (Emdin & Lehner, 2006). Since cogen was introduced for the first time in such a context, initially the students were reluctant to share their views openly in the presence of the tutor and researcher as Bhutanese students are depicted as shy in nature. Moreover, the students were also deprived of their private time as all the cogens were scheduled in the evening after class hours.

4.5.5 Semi-structured Interview

A fifth source of data was garnered from semi-structured interviews of selected pre-service teachers. The interview was mainly used to gather students’ general perceptions of the class EC but it was also used to supplement the other data sources. For example, instances such as (e.g., the tutor using local dialect, the tutor not coming to the class, or the tutor calling off the class early) captured in my diary or videotape required further explorations. Such vague instances were clarified through interviews.

Interview is one of the most efficient techniques to collect qualitative data. Qualitative interviewing is a process of finding out what others feel and think about their worlds (Rubin & Rubin, 1995). Interviews are particularly useful for getting the story behind a participant’s experiences. The interviewer can pursue in-depth information around the topic.
The qualitative interview aids in understanding something from the subject’s point of view and uncovers the meaning of their experiences. It allows people to convey to others a situation from their own perspective and in their own words. Interviews are conversations with structure and purpose that are defined and controlled by the researcher. Although the interview may not lead to objective information, it captures many of the subjective views on an issue (Kvale, 1996).

A successful interview depends on:

i. The extent of spontaneous, rich, specific, and relevant answers from the interviewee.

ii. The shorter the interviewer’s questions and the longer the interviewee’s answers, the better.

iii. The degree to which the interviewer follows up and clarifies the meanings of the relevant aspects of the answers.

iv. The extent to which interviewee responses are interpreted throughout the interview.

v. The interviewer attempts to verify his or her interpretations of the subject’s answers in the course of the interview.

vi. The interview is ‘self-communicating’ – it is a story contained in itself that hardly requires much extra descriptions and explanations. (Kvale, 1996, p. 145)

Semi-structured interviews were used as recommended by Patton (1987) and Powney and Watts (1987), where issues to be addressed were specified prior to the interview. As the conversation proceeded, the sequencing and wording of the interview questions evolved. This allowed for the coverage of major issues and provided the flexibility to probe for clarification and in-depth discussions on those issues and other relevant issues that emerged during the session (Patton, 1990). A semi-structured interview is a method of research used in the social sciences. While a structured interview has a formalised, limited set of questions, a semi-structured interview is more
flexible, allowing new questions to be brought up during the interview as a result of what the interviewee says. The interviewer in a semi-structured interview generally has a framework of themes to be explored (Lindlof & Taylor, 2002). The topic areas of interview questions were: Pre-service teachers’ experiences with the classroom climate, views on teaching and the classroom EC. Examples of the interview questions used in this study are provided in Appendix C.

However, the specific topic or topics that the interviewer wants to explore during the interview should usually be thought about well in advance. It is generally beneficial for interviewers to have an interview guide prepared, which is an informal "grouping of topics and questions that the interviewer can ask in different ways for different participants" (Lindlof & Taylor, 2002, p. 195). Interview guides help researchers to focus an interview on the topics at hand without constraining them to a particular format. This freedom can help interviewers to tailor their questions to the interview context/situation, and to the people they are interviewing (Lindlof & Taylor, 2002).

Semi-structured interviews are conducted with a fairly open framework which allows for focused, conversational, two-way communication. They can be used both to give and receive information. Unlike the questionnaire framework, where detailed questions are formulated ahead of time, semi-structured interviewing starts with more general questions. Not all questions are designed and phrased ahead of time. The majority of questions are created during the interview, allowing both the interviewer and the person being interviewed the flexibility to probe for details or discuss issues. In my study, all interviews were conducted after the class hours in the same way as cogens.

There are potential challenges to both the researcher and participants in employing semi structured interviews. Some of the strengths of using this interview technique
include provision of rich, original voices which are used to construct high-quality research accounts (Gomm, 2004). Semi structured interview was appropriate in my study where depth of meaning was important and the research is focussed on gaining insight and understanding (Ritchie & Lewis, 2003) of the EC of a B. Ed science education class. Secondly the trust and mutual respect that my participants and I shared ultimately help to legitimise the argument of the study which Gomm (2004) describes as a “fact producing interaction”. The argument is that unless an intimate, trusting and empathetic relationship is developed, the participants will not disclose the truth.

Most interviews were conducted after class hours as scheduled but sometimes the interview had to be rescheduled at odd hours intruding into their personal activities. Secondly since the interview was done in English some students failed to express and articulate their points though English is the medium of instruction in all the institutions in Bhutan.

**4.5.6 Tutor Interview – Stimulated Recall Interview**

A sixth source of data was generated from the tutor’s stimulated recall interview. Benjamin Bloom is credited for being the first person to use ‘stimulated recall interview’ as a method for retrieving memories (Slough, 2001). Since Bloom’s pioneering work, many studies have used stimulated recall to study classroom practice and interaction (Plaut, 2006; Sime, 2006; Slough, 2001) using both audio and video recordings (Seung & Schallert, 2004).

The use of video stimulated recall is popular in educational research (Gass, 2001). Pirie (1996), an Australian researcher, applied this approach in the elementary mathematics class. He let students watch video-recordings of the classroom, and select salient features of lessons to ask the students what they were thinking at particular moments in time. In another study, the students were asked to comment on important
events (Clarke, 2003). Clarke affirms that the video-recordings of classroom proceedings afford participants opportunities to recall thoughts and feelings experienced at the time of the video-recorded event.

In my study, stimulated recall interview was conducted with a teacher participant using video recordings (Gass, 2001) and observations from a researcher diary to stimulate recall of events after teaching episodes (Lyle, 2003). Stimulated recall allowed the teacher participant to explain her decision making at certain moments during lessons (Sime, 2006). The use of multimedia sources in recall sessions has the advantage of replaying and reintroducing cues that were present during the task (Slough, 2001). It was an effective way for me as a researcher to gain the perspectives of the teacher participant, her interpretation of events, and her opinion at a particular moment (Mackey & Gass, 2005).

There are challenges to both the researcher and participant in using stimulated recall interviews (Baker & Lee, 2011). It is a Western cultural technique that was adopted in a Bhutanese context. Stimulated recall interview is not generally used in Bhutanese classrooms for research so my lecturer colleague (Pelmo) encountered some problems during stimulated recall interview as Bhutanese are often portrayed as shy in communication. For instance, initially Pelmo stammered while interacting with the researcher and her face flushed while facing the camera. Any delay in the stimulated recall would lead to lapses in memory (Plaut, 2006) so the interviews need to be conducted soon after the events (Lyle, 2003) identified from the other data sources (i.e., EC, video recordings, researcher diary). Other drawbacks include participants distorting their ideas to present themselves more favourably (Seung & Schallert, 2004), adding implicit knowledge, and providing erroneous reasons for their actions (Sime, 2006).
In this study, the stimulated recall interview was held only once and that too at the end of the study period due to time constraints and too much intrusion into the work schedule of my colleague lecturer. However, an interview protocol was developed after video observations were completed as (see Appendix D) it provided important structure for stimulated recall interviews. The study by Nguyen, McFadden, Tangen, and Beutel (2013) about Vietnamese University teachers’ beliefs about learner autonomy confirms the importance of developing interview protocols for stimulated recall interview especially in a context where this research technique is new or the researcher is still a novice. Moreover, in my study stimulated recall interview was used in conjunction with other data sources thereby minimising the effect of any of the drawbacks related to this method. The questions for stimulated recall interview were also semi-structured in nature, as described in Section 4.5.5 [see Appendix D for examples of the questions used].

4.6 DATA ANALYSIS

In this study, data were analysed in an ongoing process with patterns of congruence and contradictions influencing the direction of the research (Hammersley & Atkinson, 2007). A multi-method approach was employed to analyse and interpret the various data collected.

Section 4.6.1 of this chapter describes the analysis of the students’ perceptions of the class EC. Section 4.6.2 illustrates how prosody analysis was carried out. The analysis of facial expression is discussed in Section 4.6.3, followed by conversational analysis in Section 4.6.4. The analysis of cogen was detailed in Section 4.6.5 and that of interviews in Section 4.6.6.
The following table summarises the research programme in such a way that the research questions are mapped against the data sources and analytical procedures followed by explanation of the way in which each data source was analysed.

Table 4.1

Summary of Research Programme

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Data Source</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What affects emotional climate of B.Ed secondary Pre-service teachers’ science classroom?</td>
<td>• Video clips • Emotional climate (EC) data • Interviews • Cogens • Diary notes</td>
<td>• Conversation analysis • Prosody analysis • eMotion • Ekman’s Facial Action Coding System (FACS)</td>
</tr>
<tr>
<td>2. How do pre-service teachers respond to classroom interventions to improve the emotional climate of a science class?</td>
<td>• Video clips • EC data • Interviews • Cogens • Diary notes</td>
<td>• Conversation analysis • Prosody analysis • eMotion • Ekman’s Facial Action Coding System (FACS)</td>
</tr>
</tbody>
</table>

4.6.1 Emotional Climate Analysis

The main method for determining student perceptions of the classroom EC was through their responses using clickers as outlined in Section 4.5.1. During selected lessons, each student rated the EC of the classroom on a score of 1–5 for three-minute intervals using clickers. The class average for each interval was graphically represented for each lesson. The averages of EC rating obtained in lesson 15 are shown as an example in Figure 4.2. The shape of the graph was indicative of the variation in EC within a lesson during the study. For instance, intervals (2, 7, 9 and 13) were peaks and intervals (5 and 8) were dips or troughs.

The overall mean EC for the class is indicated as a horizontal line for ease of comparison to the results for an individual lesson.
The peaks and troughs in EC graphs were used to identify relevant video segments for analysis of non-verbal conduct such as facial expressions, proxemics, prosody, and observable physiological changes (Thoit, 1990; Turner, 2007). These displays of non-verbal conduct help in the identification of human emotions (Ekman & Friesen, 1975). For instance, primary emotions (e.g., surprise, anger, happiness, fear, disgust, and sadness) are identified through facial expressions with changes in eyebrows, eye lids, cheeks, nose, lips, and chin (Ekman & Friesen, 1975). Prosodic features of speech such as pitch, energy intensity in the air, and speech rate are useful indicators of emotional states. Emotions with high arousal and activity are characterised by increased pitch, energy intensity, formant, and speech rate while withdrawn emotions are characterised by low pitch, low energy intensity, low formant, and low speech rate (Scherer, 1989). For instance, we can expect higher measurement of pitch, energy intensity, formant, and speech rate for joy than sadness. Physiological changes such as hard stare and loudness in speech indicate disgust or anger while reddening of face could mean angry or shyness (Thoit, 1990). Interactions between classroom participants in these segments were transcribed and analysed at the micro level using conventions aligned with conversation analysis (Roth & Hsu, 2010).
Frederickson (2000) asserts that the “peak-end rule” is a well-recognised method to gauge the trend in emotion and cognition. According to this trend the collective evaluations of the prior emotional experiences results from a few chosen instances held by a specific experience. These moments conform to the peak and end of the affective intensity. Durkheim’s (1995) perception of events filled with emotional energy and Frederickson’s idea on recall of emotional experiences are two frameworks in support of the argument that events experienced by participants are likely to be important in influencing their ratings of class EC.

4.6.2 Prosody Analysis

Prosodic analysis in teacher education research was first used in the ethnographic study of science intern teachers in the United States (Roth & Tobin, 2010) to study the prosody of teacher-student interactions. Roth and Tobin assert that analysis of speech parameters is a powerful tool for ethnographers who study naturally occurring situations including the emotions and changes that participants make available to one another. In this study, prosody analysis was carried out to examine how something was said during interactions. The speech parameters used in this study include, energy intensity, pitch, formant, and speech rate using PRAAT software. PRAAT (www.praat.org) is a freely available piece of software used by linguists around the world that exists for Macintosh, Windows, Linus, SG platforms. It handles a number of different sound file formats, which is saved directly from the video recorder (Tobin & Roth, 2006). Because these parameters can represent expressions of a person’s vocalised emotion, they are of theoretical interest from the perspective of the sociology of emotions concerned with understanding social phenomena in terms of interaction rituals (Collins, 2004).

Prosody analysis allowed me to review salient parts of speech (e.g., loud voice) and individual utterances that supported other data about students’ and their tutor’s
emotional arousal. Variations in pitch of speech can determine how a listener perceives what is said (Roth & Tobin, 2010) and can indicate the valence of emotional arousal (Scherer, 1989). For instance, we can predict higher measurement of pitch, vocal intensity, and speech rate for joy rather than unhappiness (see Table 4.2).

Table 4.2

Empirically-based predictions for 8 voice cues associated with the most commonly investigated discrete emotions.

<table>
<thead>
<tr>
<th>Prosodic characteristics</th>
<th>Happiness</th>
<th>Sadness</th>
<th>Anger</th>
<th>Boredom</th>
<th>Disgust</th>
<th>Surprise</th>
<th>Stress</th>
<th>Fear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch (F₀) (M)</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Pitch (F₀) (SD)</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Pitch (F₀) contour</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>M</td>
<td>L</td>
<td>HL</td>
<td>-</td>
<td>H</td>
</tr>
<tr>
<td>Energy intensity (M)</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Energy intensity (SD)</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>F1 (M)</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>-</td>
<td>L</td>
</tr>
<tr>
<td>F1 (bw)</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>-</td>
<td>H</td>
</tr>
<tr>
<td>SR (speech rate)</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>

Note: H = high; L = low; M = medium; HL = sometime high and sometime low (adapted from Juslin & Scherer, 2005)

In my study, prosodic characteristics of utterances of interest were measured for pitch or vocal frequency (F₀) in hertz [Hz], energy intensity in decibel (dB), and speech rate (syllables/s) – the main reliable variables used in studies of the vocal expression of emotion such as happiness, anger, fear, and sadness (Liscombe, Venditti, & Hirschberg, 2003; Litman, & Forbes-Riley, 2004; Scherer, 1989, 2003). These characteristics are embedded in relevant speech turns within the transcripts of selected episodes. Emotions with high arousal and activity are characterised by increased pitch, range, and variability, as well as intensity, whereas the converse is true of submissive and withdrawn emotions (Scherer, 1989, 2003).
Absolute values for the prosodic parameters for specific emotions do not exist; however, emotions were identified by comparing values of a specific utterance with other utterances, considered more neutral. For instance, the speech of a yelling speaker is expected to show increase value in pitch, increase in energy intensity, and an increased value of F1 but a decrease in F1 bandwidth when compared with neutral speech.

From these analyses, the researcher was able to reconstruct significant features of classroom events that corresponded with the EC ratings on the graph. Relevant sections of the video were transcribed to present exemplary extracts that corresponded with various EC ratings from the graphs and for the purpose of conversation analysis (Section 4.6.4).

4.6.3 Facial expression Analysis of Emotions

Facial expressions of students and their tutor were analysed qualitatively using the categories of neutral, satisfaction-happiness, assertion-anger, aversion-fear, disappointment-sadness, and disgust (Turner, 2007). These categories of emotion are used in eMotion (facial emotion software; Sebe et al., 2007). The software provided sophisticated analyses of frontal images of faces from video files to obtain measures of the emotions of the participant for each frame in a video clip where possible. This technique does not work for side images whose angle of tilt of the head exceeds 15 degrees, in which cases I referred to Ekman’s Facial Action Coding System (FACS) (Ekman & Friesen, 1975; Ekman & Rosenberg, 2005) for manual assessment of the emotions. More than one hundred years back Darwin (1872/1965) reported that facial expressions of emotion are common across culture as they are biologically determined. Since then there were few disagreements from other writers. However, later scientific investigations have proved that facial expressions of emotion are universal which was
further confirmed by Ekman and his colleagues (Ekman & Friesen, 1975. Therefore, Ekman’s system works with both the Western and Eastern cultural groups.

4.6.4 Conversation Analysis

Conversation analysis is an approach to the study of social interaction embracing both verbal and non-verbal conduct. Roth (2006) posits that social life is shaped and reproduced through interactions with others. Conversation analysis of selected interactions within the classroom was undertaken in this study.

The researcher constructed detailed transcripts of conversations from the selected video segments that were identified initially from EC data. The notation conventions from conversation analysis (Roth & Hsu, 2010; Table 4.3) were used to mark up the transcripts so that readers can understand the manner in which the words were uttered (Grbich, 2007). The transcripts provided data about how the conversations occurred, the relationships between students and their teacher, and how they produced their own actions and dealt with the actions of others (Grbich, 2007). The conversations in the classroom were analysed by considering three types of organisational features of interactions: turn taking, sequencing, and conversational repair (Roth, 2006).

Table 4.3

Conventions Used in Transcripts

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td>Bounds utterance said quickly</td>
<td># we learnt about research #</td>
</tr>
<tr>
<td>_</td>
<td>Underline for emphasis; the extent of</td>
<td>Ethnography</td>
</tr>
<tr>
<td></td>
<td>underlining within individual words</td>
<td>locates emphasis and also</td>
</tr>
<tr>
<td></td>
<td>locates emphasis and also indicates how</td>
<td>indicates how heavy it is.</td>
</tr>
<tr>
<td>:</td>
<td>Stretched-out sound/ elongation; the</td>
<td>Field</td>
</tr>
<tr>
<td></td>
<td>more colons, the more elongation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Turn taking** provided information about the social structures of power and status in interactions. The participants taking part in the conversations should take turns to speak unlike the structured classroom setting where few dominate the conversations. For instance, turn taking may have particular sanctions in a classroom where it could be considered inappropriate for students to talk while somebody is talking.

**Sequencing** is closely associated with turn taking in the sense that during conversations the participants should initiate, develop and conclude the interactions together (Silverman, 2004). For instance, in a conversation the first speaker should initiate the discussion (e.g., greetings or a question) whereas it is the responsibility of the second speaker to respond [e.g., return greetings or with an answer] (Roth, 2006).

**Conversational repair** ensures that turn taking and sequencing of the conversation in an interaction is maintained. For instance, in a conversation if the second speaker is not able to respond to an utterance initiated by the preceding speaker, the first speaker would intervene by rephrasing or rewording the question (Roth, 2006).
4.6.5 Cogenerative dialogue Analysis

The cogen proceedings were transcribed through an ongoing basis. After completing the transcription, I reviewed the video clips to confirm that the cogen interactions were captured adequately. Transcripts were refined by correcting grammar and spelling to make them more reader friendly without distorting the meaning of the sentences. Later the transcripts were made available to students and their tutor to confirm whether their opinions were appropriately recorded or whether they want to make any changes.

The findings from cogen were used to supplement findings from other data such as EC, video-based data, and interviews. The cogen findings also helped to promote rituals associated with positive emotions and deal with rituals that were associated with negative EC contradictions by adopting intervention strategies.

4.6.6 Semi-Structured Interview and Stimulated Recall Interview Analysis

Interview recordings were transcribed as the research progressed. After completing the transcription, I reviewed it with the audio recorder and diary notes to ensure that nothing was missing out and that the non-verbal cues like facial expressions and body gestures were taken into consideration. Then I corrected the spelling and grammar, to increase the readability, making sure the essence of the tutor’s and students’ comments was not distorted.

After I finished transcribing I made sure that the students and their tutor read the transcript and if they wished to make any changes or to seek further clarification. For instance, I showed a copy of the transcript and asked them “I am not sure what this [referring to an utterance] means...Could you say it again?” There were also a few cases where the quality of the audio recording was poor, so I re-played the audio in the presence of students and got the transcripts rectified with their assistance. During
interviews, on several occasions, I rephrased and reworded questions to enhance students’ comprehension of the questions.

Later I went through transcripts and looked for anecdotes and themes that were relevant to my research questions and themes that emerged in class EC, video analysis, and cogen analysis.

4.7 QUALITY OF RESEARCH

Over the period of three decades, much has been accomplished by advocates of qualitative research in demonstrating the rigour and trustworthiness of qualitative findings. Nevertheless, the quality of such research is often questioned by positivists. However, several researchers, notably Denzin and Lincoln (2000) and Silverman (2001), have demonstrated how qualitative researchers can address the issues of reliability and validity. Guba and Lincoln (1989) proposed different terminology to be used with qualitative research. They were credited for formulating four criteria to be considered by the qualitative researchers which are equivalent of the criteria used by positivist researchers. Guba and Lincoln’s (1989) four criteria of credibility (instead of internal validity), transferability (generalisability), dependability (reliability), and conformability (objectivity) are discussed below in relation to my study in Sections 4.7.1-4.7.4.

4.7.1 Credibility

According to Guba and Lincoln (1989) credibility deals with “how congruent are the findings with reality?” They argue that ensuring credibility is one of the most important factors in establishing trustworthiness. In my study the provisions such as prolonged engagement, persistent observation, triangulation, and validation of interview transcripts or classroom interactions by the researcher diary helped me to demonstrate the credibility of the findings.
4.7.1.1 Prolonged engagement

My five months of engagement with pre-service teachers and their tutor gave me enough time to understand, build trust, and establish a good rapport with them. My prolonged stay and regular interaction with them helped pre-service teachers to speak openly and reduce any possible effects of biases.

4.7.1.2 Persistent observation

Persistent observation refers to the intensity of the research (Guba & Lincoln, 1989). Whereas extended engagement with the participants exposed me to the multiple influences such as social, cultural and contextual factors that impinged upon the phenomenon being studied, my constant observations allowed me to identify events that were relevant to my study and to focus on these events in detail (Lincoln & Guba, 1985). Recording student perception of the EC at three-minute intervals in each lesson, along with extensive observations of lesson sequences fulfilled the criterion of persistent observation.

4.7.1.3 Triangulation

Triangulation involves use of multiple methods of data collection and analysis tools to investigate the same phenomenon. The use of multiple methods compensates for their individual limitations of any one method and exploits their respective benefits (Mason, 2002; Silverman, 2000). In my study, the data obtained from the classroom EC were triangulated by the data generated from cogens, conversational analysis, prosody analysis, and interviews to provide rich understandings of the pre-service teachers’ emotions and classroom EC.

4.7.1.4 Member checking

Guba and Lincoln (1989) consider member checking as a vital tool to strengthen credibility of the study. During my study, member checking was done on an on-going
basis. For example, following the cogen and interviews, I re-played the tapes/videos and went back to the students for any missing information. Later, the transcripts were circulated among students to read and confirm whether their words match with what they actually intended. Similarly, Pelmo (tutor) was also consulted and offered the opportunities to comment on her cogens and interview transcripts and verify my interpretations of the emerging inferences from the study.

4.7.2 Transferability

*Transferability* refers to a quality criterion for interpretive research that serves as an alternative to the positivist criterion of generalisability (Guba & Lincoln, 1989). Merriam (1998) posits that transferability is related to the extent to which the findings of one study can be applied to other situations. Though the significance of interpretive research is its applicability to other situations (Rossman & Rallis, 1998), it is also considered a challenge due to the subjectivity from the researcher as the key instrument, and is a threat to valid inferences in its traditional thinking about research data. However, a qualitative researcher can enhance transferability by detailing the research methods, contexts, and assumptions underlying the study. Seale (1999) advocates that transferability is achieved by providing data sets and descriptions of the settings studied that are rich enough for other researchers to judge and apply the findings to other contexts. Therefore, it is imperative that the researcher documents and justifies the methodological approach, and describes, in detail, the critical processes and procedures that have helped him to construct meanings from the data sources.

I do not intend to generalise this case study however, the transferability of the study was made possible through the provision of sufficient contextual information about the fieldwork sites (see Section 4.4), thick descriptions of the phenomenon under investigation (Guba & Lincoln, 1989), detailed documentation of how data were
processed (Chapter 5 & Chapter 6). This detailed documentation of the study context, data handling and processing will allow readers and future researchers to make judgments about the transferability of the research to their own studies or with those that they see emerging in their situations.

Further, throughout the process of this study, the researcher was sensitive to possible biases by being conscious of the possibilities for multiple interpretations of reality.

4.7.3 Dependability

Dependability refers to the generation of similar research results if the works were repeated in the same context, with the same methods, and with the same participants (Guba & Lincoln, 1989). However, the changing nature of the phenomena scrutinised by interpretive study renders such provision problematic in their work. My study reported a detailed process and methods within which the research was carried out to develop a thorough understanding of the methods and their effectiveness for other researchers.

4.7.4 Confirmability

Confirmability requires one to ensure that the findings are the result of the experiences and ideas of the participants and not that of the researcher (Guba & Lincoln, 1989). Narrative vignettes and direct quotes from my diary notes strengthened the confirmability of my account. The vignettes demonstrate how I made plausible interpretations of the data, allowing the reader to act as a co-constructor of meaning, and to make judgments about my account’s credibility. I discussed my pre-conceptions and background experiences allowing the reader to know the lens through which I viewed the phenomenon. By presenting a detailed, comprehensive, and coherent account, I allowed the reader to act as a co-analyst of the study and make judgments about the
strength of the assertions that are presented. The role of triangulation and member checking was emphasised to mitigate the effect of researcher bias.

4.8 ETHICAL ISSUES

Ethics are of great concern in research, especially when human subjects are involved. Researchers must always be conscious of the problems their study can create and make every effort to minimise or eliminate any harm to their research participant (Hughes & Hellings, 1991). Ethical clearance to conduct this research was obtained from QUT (Ethics Approval number: 1100001404 [Appendix E]). I gained the consent of the Director, Department of Research and External Relations, Office of the Vice Chancellor (OVC), RUB (Appendix F) and the Director of the Case College of Education, where Pelmo is employed (Appendix G). Informed consent was also procured from pre-service teachers participating in the research (Appendix H) after having briefed and read the information sheets provided to the pre-service teachers.

In selecting participants for the cogen and interview, students were not coerced or obligated to participate but they volunteered for the good of improving learning and teaching in their classrooms (Tobin & Roth, 2006). They were also briefed that the classroom proceedings and cogens will be video recorded and they have options to decline to the video or audio recordings. Consent was also obtained from students and their tutor to show a video-clip to a class or other researchers in the context of educating others or disseminating what we have learnt from the study (Appendix I).

To maintain anonymity and safeguard the participants, pseudonyms were used to represent them. The names of the male students start with the letter ‘S’ and those of female students with the letter ‘C’. All data resources, including researcher diary, videotapes, audiotapes, transcriptions, and interpretive documents were kept under lock
or password protected databases in the researcher’s office. These data will be destroyed soon after the time specified by the Ethics committee at QUT.

4.9 CHAPTER SUMMARY

This study employed an interpretive approach using an ethnographic case study design. Multiple data collection tools (e.g., classroom EC, video recordings, interviews, cogens, and diary) were used to access data during the study. The participants for the study consisted of 10 female and 18 male science students along with their tutor exhibiting diversity in gender, ethnicity, and academic standards. This study design was appropriate for me as I could collect multiple data from the perspective of an insider being in their class, observing and interacting with them for five months.

The classroom proceedings of selected lessons were video recorded along with the rating of the classroom EC by students at three-minute interval using clickers. Diary notes were maintained by the researcher to supplement findings from the classroom proceedings. Cogens were held at regular intervals to reflect on the classroom practices that worked and that needed to be rectified with selected students and their tutor. All the students and their tutor were interviewed to obtain their perspective of their positive and negative feelings during classroom interactions and what triggered those feelings.

Furthermore, multiple methods of analysis were utilised to analyse and triangulate the findings. The analytic process was both complex and exciting having to move back and forth between data and assertions. The meso-level analysis of the classroom interactions helped generate assertions which provided a synopsis of the nature of the classroom EC. These assertions were addressed following the micro-analysis of the speech parameters extracted from video files identified by the peaks and troughs generated by the students’ ratings of the class EC. The prosodic analysis was
supplemented by other data such as conversational analysis, diary, excerpts from interviews and cogens, and nonverbal behaviour such as facial and bodily cues.

To uphold the quality of the study, the four criteria proposed (Guba & Lincoln, 1989); that is, credibility, transferability, dependability, and confirmability were employed. The QUT code of research ethics was strictly adhered to throughout the study process. The following two chapters (Chapters 5 and 6) describe the results of the study which are organised into two key areas: classroom EC and interventions to transform classroom EC.
Chapter 5: CLASSROOM EMOTIONAL CLIMATE RESULTS

5.1 INTRODUCTION

As described in Chapter 4, the principal method for determining student perceptions of the classroom emotional climate (EC) was through their responses using audience response technology called clickers. The data were gathered on a five-point scale at three-minute intervals for 16 lessons. The class average for each interval was graphically represented for each lesson.

Out of 23 lessons that were video recorded, the clickers were used in 16 lessons to rate the class EC. Each graph for each lesson was inspected to identify those intervals that peaked well above the mean and those intervals that dipped below the mean. Typically, there was considerable variation across intervals for each of the 16 lessons. The overall EC mean ranged from 2.5–4.0, which means some intervals had means as high as 4.0 and others as low as 2.5. The overall mean EC for the class over the five months study period was 3.2.

Data from other sources such as interviews, researcher diary, and cogens were used in conjunction with the video data to support claims about relationships between the type of class activity and relationship structure in the class with the valence of EC that were derived from the video analysis.

The category types of activities refer to students’ use of artefacts like video clips and scientific models to supplement their presentation of a science concept, interactive whole class discussion, class led by student presenters, group work, formal lectures, and the presentations led by unprepared student presenters, whereas the category
relationship structure relates to humorous moments in the classroom, the tutor supporting students’ work and violation of classroom rituals by the tutor and students.

In this chapter data analyses are presented that relate to the first research question What affects the emotional climate of a science classroom for pre-service teachers in Bhutan? Analyses in this section focus on the relationship between the type of class activity and relationship structure with the valence of EC.

Two general assertions were developed from the analysis of the data: 
Assertion 1: The valence of emotional climate depended on the type of activity in which classroom participants engaged.

Assertion 2: The valence of emotional climate depended on the type of relationship structure present in the classroom.

These two assertions are elaborated further in this chapter through a series of sub-assertions. Section 5.2 addresses assertion 1 and the related sub-assertions, and assertion 2 and sub-assertions are addressed in Section 5.3. The key outcomes are summarised in Section 5.4.

Activities that produced positively valenced EC in the class comprise of students’ use of video clips, scientific models to supplement their presentation of a science topic, and interactive whole class discussion. Negatively valenced EC or low EC is generated during formal lectures and when the presentation is led by unprepared student presenters. Student group work activities produced both positively valenced EC and negatively valenced EC. The emotions during group work are negatively valenced when student group work was prolonged.
5.2 Assertion 1: The valence of emotional climate depended on the type of activity in which classroom participants engaged.

Swarat et al. (2012) investigated how aspects of the learning environment in a middle secondary school in the United States affected student interest in science. Through survey and interviews they found that the types of activities students engaged in during lessons had the most profound effect on their interest in science. The study reported that students had higher interest in hands-on activities like computer work, video clips, working with models, interactive discussions, and lower interest in reading text and attending lectures. Even though my study did not set out to measure interest, I was able to identify a relationship between the types of activities that the students were engaged in and those activities that were associated with positive EC and those that were associated with negative EC or low EC. In this section, I discuss the relevant data related to activities that were associated with positive EC and negative EC or low EC in turn below.

Group work activities produced mixed EC valences. Sometimes students reported positive EC from group work activities, yet at other times the EC was negative. For instance, when group work activities commenced there was synchrony in mood, gaze, and laughter among students. Conversely as the group activities were prolonged there was a lack of shared mood and emotional entrainment observed previously and the EC dropped in some intervals. Notwithstanding this anomaly, the overall results reinforce the findings by (Swarat et al., 2012) that activity matters.

5.2.1 Assertion 1.1: Positive emotional climate was associated with activities involving students’ use of video clips (video assisted activities).

In the context of this study video assisted activities refer to classroom presentations led by students using short video clips to supplement their explanation of
a science concept. Here the students in pairs or individually were required to lead a session on selected science topics from high school Physics. Such exercises aimed to provide students with first-hand experience of leading a class prior to their field experience and to familiarise them with the school science syllabus (SCE, 2009). When student presentations were scheduled the class typically started with the presenter showing a concept map of the key science topic using power point. Video clips were embedded in their power point presentation to highlight the concept. Following the presentation students discussed the concept for ten minutes in their groups, which was closely monitored by the tutor and the presenter. After group discussion, the tutor and presenter facilitated whole class discussions.

During the study period there were only five lessons that included video-assisted activities. Figure 5.1 presents the EC for these five lessons. Each lesson consisted of a different number of intervals, specifically lesson 12 (L12) had 16 intervals, lesson 13 had 15 intervals, lesson 15 had 13, lesson 20 had 19 and lesson 22 had 17 intervals. As explained in Chapter 4, interval refers to lesson segments of three minutes duration prior to the students’ rating of class EC using clickers. Mean EC values for each three-minute interval was manipulated from their ratings and were subsequently graphed to capture variation in EC for each interval for every lesson. Figure 5.1 presents one interval for each of lessons 12 and 13, four intervals for lesson 15 and three intervals for lesson 20, and two intervals for lesson 22 that had video presentation. The average EC of the lessons, that had students’ presentations assisted with video clips was very positive (3.6). In-fact it was the highest average EC recorded across lessons (intervals) associated with activities. Specifically, higher positive EC was reported in lesson 12 (Interval 2) lesson 13 (Interval 1), lesson 15 (Intervals 2 and 13), lesson 20 (Interval 4), and lesson 22 (Interval 2). The highest EC (4) across all intervals was recorded in
interval 2 of lesson 15. The Lowest EC of 3 (i.e., below the average EC for all lessons [3.2]) was recorded in interval 6 of lesson 20. When the video clip commenced the EC was 3.7 at interval 4 and gradually declined to 3 as the video clip prolonged in interval 6.

![Figure 5.1. Mean ratings of emotional climate at three-minute intervals for video assisted activities.](image)

The overall mean EC for the 16 lessons (3.2) is shown as a straight line for ease of comparison. The intervals were represented by numbers reflected on the chart for easy identification. For instance, number 1 on the chart in lesson 13 indicates interval 1 and number 2 in lesson 12 represents interval 2 and so on (Figure 5.1).

Video analysis reveals that the introduction of video clips as a part of the lesson was, in the main, well received by both the students and tutor. In lesson 15, for example the class was noisy during the interval (i.e., interval 1) prior to the video clip with students moving around as they were getting ready for the class. The EC at that time was recorded at 3.2. As the video commenced the students went silent and there was a decrease in energy intensity from 0.33 µWatts/m² (80 dB) at interval 1 to 0.32 µWatts/m² (78 dB) at interval 2. The clip consisted of an animated explanation of \textit{torque} and its application in our everyday life with English subtitles. The 2 min 10s
video clip on *Torque* (Lesson 15, Interval 2) presented by Singey generated mutual focus among students and the tutor. For instance, the moment the video clip was projected on the screen most of the students and Pelmo, the tutor (Tr) aligned their bodies and gaze towards (Figure 5.2a) the screen. Figure 5.2b also shows students [S] (S14, S5, S26, and S23) leaning forward and with their gaze focussed on the screen. The EC for the interval was 4 – the highest across all lessons.

![Figure 5.2](image)

*Figure 5.2.* (a) The tutor and almost all the students fixed their gaze towards the screen. (b) Students (S14, S5, S26, and S23) with body leaned towards screen.

Similarly, mutual focus was produced when students were viewing a video clip on the concept of *Force* (lesson 13) with cartoon animation. An image of some students and the tutor from the classroom taken during this interval (i.e., Interval 1, Figure 5.3) shows the students and tutor looking at the screen. Their eye gaze and bodies are oriented toward the screen suggesting that they were engaged in this activity.

More specifically, Figure 5.3a shows the video animation has entrained Sangay (S6) and Sogyal (S2) into laughter as evident from their bodies aligned towards each other and their elbows in contact with their hand covering their mouth to conceal their laughter. This occurred at the same time that the video animation showed a duck kicking a football to demonstrate that force can change the direction of an object. Prior to seeing this video image, Sogyal (S2) was laughing out hysterically with his body moving back and forth. Other students (S15, S5, S21, S4, S16, and S7) were also seen
laughing with their gaze fixed on the screen and their bodies aligned to the screen (Figure 5.3b). A higher positive EC was rated at 3.9 during this interval. Student 20 was seen smiling at the outset of the video clip. Such synchrony in gaze (i.e., students turning their attention towards the screen simultaneously), body gestures and collective laughter reinforces the assertion that animated video clips produced mutual focus and synchronised gaze, ingredients necessary to generate shared emotion and positive emotional energy (Collins, 2004).

Figure 5.3. Evidence of mutual focus and shared emotion. (a) Student 6 and Student 2 body aligned towards each other with hand covering mouth to conceal laughter. (b) Students with fixed gaze and body oriented toward screen and smiling.

During interviews and cogens students used various expressions to communicate their experiences with the video-assisted activities. Student 22 claimed that it helped him to refresh his memory of science concepts learnt during school days and remain attentive during the lesson presentation (Cogen 7). Student 16 asserted that it gave him practical experience and made abstract concepts clearer (Cogen 7), and it assisted him to visualise and comprehend how natural phenomena like sound waves are produced rather than reading from the science textbooks (S9, Cogen 7).

Student 10 felt excited as he was the first student presenter to use a video clip in a presentation. He said:

When I was leading a session on “Newton’s Laws of Motion” I sensed that my friends were very excited and curious as I could spot smiles on their faces. The
session became very interesting and informative as the video clip conveyed all about the laws of Newton. Because of that they could successfully carry on the class discussion by recollecting what they have already learnt about Newton’s Law theoretically. (Personal Interview)

The positive climate sensed by Student 10 was also echoed by Student 13 when he referred specifically to the usefulness of the animated video clip, as follows:

I felt very happy because the animated video clip on the three laws of Newton was very good. I could relate that with theory of the three laws. That gave a clear concept of how Newton’s Laws work. (Personal Interview)

In another incident (Interval 5, Lesson 20), Student 6 expressed that he had only a vague idea of how rays and images were formed by mirrors until a video clip of ray diagrams was shown. Though the clip lasted for only five minutes, he said he desired to use such video clips in future to teach his students in school. He said “such clips will help clarify things and moreover, students can see the practicality of the concepts through such animations.”

The tutor was also appreciative of how video-assisted activities helped students to supplement their presentation. She was fascinated by the way Singey (S3) used video clips to explain “how gears work” in lesson 15, interval 13. She expressed “that was the best part of the lesson, if it was me, I could have simply lectured or explained verbally the Physics concept. I enjoyed the lesson and the concepts became clearer though I have learnt these things during my school days” (Personal Interview). The interactions are captured in Figure 5.4. It shows the tutor, Chenzom (S15) and Choeden (S5) (others not visible) giving a round of applause to Singey (presenter) immediately after he projected a clip showing how gears work. This was clear evidence of spontaneous positive emotional energy among students.
Unlike interval 2 of lesson 15 where the EC was 4, the EC in the next interval (Interval 3) dropped to 3.5, possibly due to the prolonged display of a video clip. This trend also was observed in lessons 20 and 22. For example, the EC dropped from 3.7 in interval 4 in lesson 20 to 3.4 in interval 5 and further down to 3 in interval 6 when the clip showed for more than 7 minutes. This suggests that the novelty of a short video clip has greatest impact on EC in short intervals of time. This inference was supported by Student 9 who said “some video clips were too long and not very informative which made us feel negative” (S9, Cogen 7).

The observations that I recorded in my diary report that whenever video clips were shown, students’ attention was drawn to the screen with smiles on their faces. The excitement that they have gained from the video-assisted activities helped students comprehend the concepts according to their self-report during interviews and sustain their interest for the remaining time in the class.

Experiences that led to high levels of mutual focus of attention occurred not only with video clips as described above but also with the activities assisted with models discussed below.
5.2.2 Assertion 1.2: Positive emotional climate was associated with activities involving students’ use of models.

One of the activities that generated positive EC in the class was identified as student presentations assisted by models. Here *models* refer to scientific artefacts used by students to assist their presentation. As part of their training program, the students are required to acquire skills of designing and improvising models using locally available resources. They are expected to produce scientific models using locally available resources if they are placed in remote schools without access to a science laboratory. For instance, the top part of a beer bottle can be used as a funnel and the bottom portion as a beaker when halved. Similarly a fused electric bulb can be used as a round bottom flask (SCE, 2009).

The students in groups came up with four models. I observed the presentation of three models in lesson 16. Singey (S3) was the first to present on behalf of his group and his model was called *Factory*. The next model was presented by Sogyal (S2) followed by Sithup (S11) on the model *Gear*.

Figure 5.5 reveals that the average EC during those activities was positive (3.5) for the lesson which had students’ presentations assisted with models. In particular, higher positive EC was reported in interval 5 (Singey’s presentation, Figure 5.5) and interval 1 (Sogyal’s presentation). When Singey commenced his presentation, the EC was 3.8 at interval 5 and gradually declined to 3.4 as he prolonged his presentation in interval 6. Similarly for Sogyal, the EC dropped in the next interval. Though the EC dropped in intervals 6 and 2 possibly due to a prolonged presentation, the EC of the class remained (positive) above average EC for all lessons (3.2).
Figure 5.5 shows that the presentations associated with models were well acknowledged by the students as the average EC during model presentations was positive. Video analysis shows that Singey was quite articulate through his gestures and body movements during his presentation (Figure 5.6a). Furthermore, his in-depth knowledge on the subject, hand movements (gestures), creation of humour occasionally and the tutor and other students reciprocating with a gaze fixed on him and smiling during his presentation indicates synchrony and mutual focus among the students as evident in Figure 5.6b.

Figure 5.6. Evidence of mutual focus and emotional entrainment amongst students during Singey’s presentation. (a) Singey presenting his model “Factory” (b) The tutor and students (S4, S12, S13, S1, and S14) reciprocating with fixed gaze, body leaned forward and laughter.
Figure 5.6b shows students and the tutor with their bodies and heads leaning toward Singey (presenter) while smiling. Of the 28 members (rest are not visible in Figure 5.6b) 5 members (S4, S12, S13, S1, and S14) have their gaze fixed on Singey, and their smiles indicated positive emotional arousal. Singey is seen explaining the functions of his model Factory based on the Physics principle “hot air rises and cold air sinks” using hand gestures to emphasise his points (Figure 5.6a).

Furthermore, the conversation generated during Singey’s presentation produced a positive EC of 3.8, the highest EC for that class. The interactions are represented in Extract 5.2.

Extract 5.2: Activities Assisted with Model - Lesson 16, Interval 5.

<table>
<thead>
<tr>
<th>Turn</th>
<th>Speaker</th>
<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Singey</td>
<td>((smiling at the class holding his model)). This is a factory. Do you believe it?</td>
</tr>
<tr>
<td>02</td>
<td>Student 4</td>
<td>[YES]</td>
</tr>
<tr>
<td>03</td>
<td>Singey</td>
<td>[Druk] factory ((smiles))</td>
</tr>
<tr>
<td>04</td>
<td>Students</td>
<td>((Broke into laughter and giggles))</td>
</tr>
<tr>
<td>05</td>
<td>Student 7</td>
<td>(3s) once [more]</td>
</tr>
<tr>
<td>06</td>
<td>Student 24</td>
<td>[once more]</td>
</tr>
<tr>
<td>07</td>
<td>Singey</td>
<td>this is () Druk factory to produce candle and incense sticks ((smiles))</td>
</tr>
<tr>
<td>08</td>
<td>Student 8</td>
<td>Druk factory</td>
</tr>
<tr>
<td>09</td>
<td>Singey</td>
<td>Factory</td>
</tr>
<tr>
<td>10</td>
<td>Students &amp; tutor</td>
<td>((laughter))</td>
</tr>
</tbody>
</table>

Extract 5.2 provides a prelude to the structure of the interactions that are associated with this study. Singey’s first statement, turn 01 contains a positive non-verbal “smile” as he introduced his model Factory by holding it up and asking a rhetorical question to the class. Student 4 confirms it by uttering a loud YES in turn 02. By adding the word Druk to the factory meaning Bhutan Factory in turn 03 while smiling, humour appears to have been generated as evidenced by students breaking into laughter and giggles in turn 04. Overlapping speech in turns (02-03) and in 05 and 06 happens so fast that there is no pause between the utterances providing evidence of synchrony. The (3s) pause by
Student 7 in turn 05 communicates his apology for not getting the name of the model right as Singey added a word *Druk* to the initial factory name. Singey stressed Druk factory as the name of his model and further adds humour by saying it can produce candles and incense sticks. As he uttered the word *Druk Factory* in turn 07, his mouth was open with teeth exposed and corners of lips drawn back and up. Creases running down from his nose to the outer edge beyond the corners of lips indicating happiness (Figure 5.7) as his facial expressions corresponded with Ekman and Friesen’s (1975) facial characteristics for happiness. Furthermore eMotion software reads this expression *Druk Factory* as 100% happiness (Figure 5.7).

**Figure 5.7.** Singey expressing happiness through the display of his model.

According to Scherer (1989) absolute values for the prosodic parameters for specific emotions do not exist; however, identification of emotions is done by comparing values of these parameters with similar utterances, considered more neutral under typical conditions. For instance, high intensity happiness is expected to show increases in values in F₀ mean, increased mean values of energy in air, and an increased value of F₁ mean (M) but a decrease in F₁ bandwidth (bw) when compared with neutral speech for a particular speaker.

The prosody analysis of the emphasised words *Druk Factory* in turn 7 confirms that Singey was happy as there was an increase in pitch (F₀=200Hz v 183Hz) and
speech rate (speech rate=4.10 syllables/s v 4.05 syllables/s) when compared with the similar utterance considered neutral in turn 03. This inference was supported by the chain of interactions (in turns 01-09) where one person’s statement that is directly followed by another with minimal pauses indicates synchrony in the interaction. Furthermore, the laughter generated in turn 10 among the tutor and students was indicative of positive emotional energy that eased the transition to the next presentation by Sogyal. Sogyal was equally excited as he presented his model to the class with a similar facial expression to Singey that indicates happiness (Figure 5.8).

Most students expressed in the interviews that their presentation on models were well received by the tutor and friends. For instance, Student 27 expressed “I enjoyed and felt quite motivated looking at different models and listening to their presentation.”

The most satisfying moment for students was when one of the groups came up with a new model. Student 15 expressed:

What I liked most about this work was that one of the groups came up with a new model which could measure the temperature of a liquid. This shows their creativity and innovative skills. If not for this class they won’t have got a chance to show their skills and creativity. (Personal Interview)
The positive experience sensed by Student 15 was also echoed by Student 8 when he referred specifically to the skills acquired from this class, as follows:

The class on presentation of models was very positive for me as it gave us a sense of satisfaction for having designed and presented to the class. The skills I have learnt from this will go a long way later as we graduate from the college and become teachers. Many schools in Bhutan are located in far flung places and some do not even have a decent chairs to sit on forget about other amenities. In being a science teacher I will have to use these skills to improvise science models with the locally available resources. (Personal Interview)

5.2.3 Assertion 1.3: Students experienced heightened shared positive emotions and emotional energy when engaged in interactive whole-class discussions.

Figure 5.9 shows the EC ratings for intervals from each lesson in which interactive whole class discussion occurred. The EC during interactive sessions were positive as the mean EC stands at 3.4. The maximum EC was recorded at 3.7 in lessons 9 (Interval 6) 13 (Interval 4) and 20 (Interval 15). The minimum EC of 3.1 was recorded in interval 12, lesson 20.

![EC for interactive whole class discussion](image)

*Figure 5.9. Mean ratings of emotional climate at three-minute intervals for interactive whole class discussion.*
In the context of this study, *interactive whole class discussions* refer to classroom opportunities where students can simulate the role of a teacher to discuss the issues related to teaching Physics in schools and problems associated with Physics content, and engage in informal debate to give a wider perspective on issues or concepts being discussed. Such activities helped the tutor to engage students, especially the shy ones. This enabled them to contribute to the classroom discussion. It also afforded them the flexibility in the choice of examples and approaches to the concept being discussed in the class, besides making learning livelier through active student participation, as evident from the discussions that follows.

In this section, I present evidence from three different extracts closely supported by data from cogens and interviews to build an argument that interactive whole class discussion provided opportunities for students to contribute to the production of positive EC. I begin by illustrating how a group of students generated positive emotional energy through interactions with Sergyal (presenter) and the tutor in interval 6, lesson 9 (Extract 5.3). This was followed by the analysis of similar features one week later in interval 9, lesson 11 (Extract 5.4) and further analysis of interval 11, lesson 15 (Extract 5.5) a few days later. Positive emotional arousal was generated through the exchange of laughter, display of positive bodily cues, and the overlap of speech as evident from the analysis of the conversations detailed below.

Interactions that lasted for 25 minutes between Sergyal (presenter) and his friends and the tutor are analysed in Extract 5.3. The topic of discussion was *What is the relationship between density of an object and upthrust?*

The tutor was sitting among students as Sergyal led the session on *Archimedes Principle*. Sergyal started the session by presenting a concept map followed by group discussion. After ten minutes of discussion Student 5 stood up and posed a question in
In a Bhutanese context it is customary for students to rise before they engage in any interactions as a mark of respect for the teacher and the class. But in the milieu of this class students standing up and raising hands (turns 01, 02, 14, 19, and 23) signals co-presence, sense of belongingness and willingness to participate in the discussion, a condition necessary for the establishment of interaction ritual chains associated with positive emotional energy (Collins, 2004).

Extract 5.3: Interactive Whole Class Discussion - Lesson 9, Interval 6.

01 Student 5 (Stood up, ) Can you tell the relationship between the density of an object and upthrust?

02 Sergyal (Standing (4s)) (maintaining eye contact with student 5). Sorry, your question is what is the relation between density and upthrust?

03 Sogyal Density of a body

04 Student 5 Density of a body

05 Class Density of a body (speaking in unison)

06 Sergyal Higher the density of the body higher will be the upthrust (3s) larger the density higher the upthrust.

10 Sogyal (shaking his head)

Sergyal was apologetic for not understanding the question correctly, so he reconfirmed the question in turn 02. Sergyal’s (4s) pause in turn 02 indicates his hesitation to confirm the question initially. The overlapping speech in turns 3 and 4 with no pauses indicate synchrony in interactions. Sergyal’s (3s) pause in turn 06 suggests either he is not sure of the answer or is searching for the right word. Sogyal was seen shaking his head (turn 10) disapproving the response given by Sergyal thereby creating a resource for further discussion.

14 Student 6 OK, then one question from here (stood up). For instance, if you take a ...take a bucket of water and if you place a drop of mercury on the surface of water, will it float or sink?.

18 Sergyal ((Maintaining eye contact with Student 6)) I think you are confused with the question. For instance, if you take mercury and water, you know mercury has more density.

19 Student 19 ((stood up)) I will answer his question. If the upthrust is greater than the weight of an object then it will float, isn’t it. So again if the upthrust is less than the weight of
an object, it will sink, but his question is (staring at Student 6); if he drop a little amount of mercury in water, the upthrust will be more as the area of mercury will be less.

23 Sogyal ((Raise his hand and stood up)) ah...I feel it is not that the answer is wrong, but it is the question that they are not clear about ((students staring at Sogyal)). (.) I feel the question should be “what is the relationship between density of a body immersed in a liquid and the upthrust produced by the liquid?” ((Sogyal using hand gestures))

39 Tutor Iron nail sinks in water whereas boat floats. That means here we have to apply the principle of floatation. (4s) Now who asked that question? Are you clear or do you still feel something is wrong with our explanation.

40 Sogyal (2s) still something is wrong, madam.

44 Tutor ((concluded since it was lunch time)). Now lunch is more important.

45 Students ((The class broke into laughter and dispersed for lunch))

The tutor summed up the answer in turn 39 and confirms with Student 5 whether she is satisfied with the response provided, to which Sogyal disagreed (40). A pause of (2s) indicates Sogyal figuring out whether it would be polite for him to question madam. This rare act of students questioning the teacher in the Bhutanese context is positive as it shows that the relationship between students and the teacher is changing. Traditionally students fear teachers — this change suggests that the teacher’s role is emerging as a friend and a guide. The discussion could have continued if not for the tutor who after noticing the tired body language of students called off the class by making a humorous remark “Now lunch is more important” (44) which generated laughter in the students in turn 45.

This interaction was positive as most students shared their views and opinions on the given concept. A total of 12 students (10 males and 2 females) participated in the classroom activities and some students participated more than once taking the frequency of total students’ participation to 49 within 25 minutes. For instance, Student 6 participated 10 times, while Students 2 and 9 participated 7 and 5, times respectively.
Students also felt more comfortable to interact when the session was led by one of their student colleagues as the chances of their comment getting cajoled or derided would be less: For instance Student 21 expressed:

For me, I feel positive when the class is led by students on different topics. The presentation is supplemented by video clips and there is interaction among students and with the tutor. It also offers opportunities for us to ask questions and participate in the discussions. Such classes motivate us. For example, the class on density was very interactive and lively. I learnt a lot listening to the discussions and arguments that surfaced in the class. (Personal Interview)

The above view was supported by the tutor when she expressed:

There are lots of differences when I teach and when students teach. When I teach, mine is more on power point or chart paper. There are fewer questions from students and even the questions are not critical which I can easily answer. When students present, most of the times students ask lots of questions and some of the questions could not be answered even by me. I feel students are learning more when they are presenting because they come prepared as they want to look good. (Personal Interview)

This excerpt was the longest discussion in a single class with an unfolding array of positive emotionally charged interactions with reference to the relationship between density and upthrust, a structure that recurred in the next episode in a different group on the topic of Motion in one dimension.

One week later, the topic of the lesson was Motion in one dimension (Interval 9, Lesson 11) led by Chenzom and Choki. Prior to the whole class interaction, the students were supposed to discuss the topic Motion in one dimension in groups following the introductory remarks on the topic and briefing on the task ahead by Chenzom. As the group started to read and discuss the topic, the tutor circulated to clarify any doubts. Like Extract 5.3, this topic (Extract 5.4) also provided opportunities for students to open up and share their perspectives on the given topic. There was positive emotional energy and mutual focus as evident from the smiles and body position of the tutor and students’
bodies leaning forward with their gaze fixed on Chenzom as she started to demonstrate (Figure 5.10).

Extract 5.4: Interactive Whole Class Discussion - Lesson 11, Interval 9.

01 Student 6 Umm...Can you give an example where distance is not zero but displacement is zero?
02 Chenzom ((stood up)) I can demonstrate, madam.
03 Tutor ((smiling)) she can demonstrate, OK. The question is ah...give an example where distance is not zero but displacement is zero.
04 Student 25 Circular |path|
05 Student 7 |Circular path|
06 Chenzom OK. Look at me ((positioning herself to demonstrate))
07 Tutor Initial point ha...ha...ha...
08 Chenzom ((standing behind the tutor)). This is my initial point. She walks around.
09 Students ((staring and laughing in unison))
10 Tutor ((As Chenzom walks around)) (4s) what is she doing? ((staring at the class))
11 Chenzom I am moving around, I am covering some distance...
12 Student 25 ...at a uniform speed

Chenzom volunteered to perform a demonstration (turn 02) to answer the question raised by Student 6 in turn 01. This was a very positive move for the class especially the girls, as girls in this class seldom participate in class discussions. Finding a female volunteer, the tutor was pleased as evidenced from her smile and eye contact with the class when she uttered “she can demonstrate” in turn 03 (Figure 5.10a). The tutor’s broad smile was indicative of happiness and satisfaction (Ekman & Rosenberg, 2005). The overlap of speech in turns 04 and 05 generated synchrony as they were responding in agreement to the question posed in turn 01. The mass laughter and students repositioning themselves to get a better view of Chenzom provides evidence of synchrony between students and Chenzom who was conducting the demonstration thus generating mutual focus and emotional entrainment (06–11). For example, Figure 5.10b shows students (S9, S13, and S1) with their bodies and gazes entrained with the
demonstration Chenzom was conducting. Chenzom’s utterance in turn 11 is completed by Student 25 in turn 12 illustrating a level of synchrony (Collins, 2004).

![Figure 5.10](image)

*Figure 5.10.* (a) Tutor smiling and (b) students gaze fixed and body aligned to demonstration, indicating mutual focus and emotional entrainment among students.

A couple of days later, the session on *Turning Force* (Interval 11, Lesson 15) by Singey (Extract 5.5) was the most jovial of the three events discussed here. The discussion drew on the anecdotes from everyday examples. The whole class broke into laughter on occasions, elevating energy levels. The EC became more positive as the discussion progressed as evidenced from the small rise in EC from 3.2 in interval 8 to 3.6 in interval 11. As detailed below in the excerpt from Interval 11, Lesson 15, the topic of discussion was the *Centre of Gravity*. The interactions started with Sangda asking humorous question of the presenter (Singey) in turn 01. His question generated excitement in students as laughter erupted from the whole class (02). His question also invited lots of responses from fellow students in turn 3 but unfortunately their voices were not captured by the camera.

**Extract 5.5. Interactive Whole Class Discussion - Lesson 15, Interval 11.**

<table>
<thead>
<tr>
<th>Turn</th>
<th>Speaker</th>
<th>Utterance</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Sangda</td>
<td>In stability the lower part of the body should be made heavy but in case of human, it is said our head is heavier than the body. So we should be upside down. Why is it not happening?</td>
</tr>
<tr>
<td>02</td>
<td>Students</td>
<td>((class broke into laughter))</td>
</tr>
<tr>
<td>03</td>
<td>Various views were expressed by Samphel, Serpo, Sergyal and Shacha but ()</td>
<td></td>
</tr>
</tbody>
</table>
Tutor: ah... just listen here... Which of the two will have more surface area? Human head or our juta or slipper when it is in contact with the ground.

Students: Juta or slipper madam ((unison))

Tutor: yeah

Tutor: Juta will be more because the base is more. (4s) somebody said earlier the centre of gravity is within our body. Do you know where it is?

Sangda: Pointing toward their face and running down the body.

Tutor: Show me turning toward the left where it is? Where is our centre of gravity? Fingers clasp together.

Student 4: here madam pointing toward his stomach

Students: ((All class broke into laughter))

Tutor: I KNOW YOU ARE SHOWING SOMEWHERE IN THE ABDOMEN, but we don’t know where it is ((smiling)).

The tutor intervened in turn 04 and explained the concept using anecdotes from everyday examples. Students confirming tutor’s question in turn 5 and the tutor using local dialect “juta” for shoes in (turns 4 and 7), and students reciprocating with the utterance of juta in turn 5 while smiling (Figure 5.1a) indicate synchrony and mutual focus, respectively.

![Figure 5.1](image-url)  
*Figure 5.1:* (a) Tutor smiling and body leaned forward with fist clamped and students (S5, S21, S28, S19, S12, and S3) reciprocating with smiles. (b) Students (S27, S15, S5, S26 and the tutor not visible) entrained with laughter.

Samdrup (S4) in an attempt to convince his friend and the tutor (turn 10) that the location of the centre of gravity in the human body is near the abdomen entrained the students and tutor into laughter in turn 11 as evidenced in Figure 5.1b. Figure 5.1b shows students (S27, S15, S5, S26, the tutor and rest of the students not visible)
laughing as Samdrup gestures his hand toward his abdomen to show the location of the centre of gravity in the human body.

Almost all of the students (80%) interviewed claim that they feel positive when the session is interactive as the class becomes lively. There is mutual focus and a shared mood while bringing their perspectives forward or responding to queries from the students. This inference was supported by Student 7, who expressed:

The lesson on *Motion in one Dimension* was positive. The class was very interactive, the questions which the presenter could not answer were answered by the tutor and in case she failed to answer it was directed to the floor. In this way, the whole class was involved in the discussion. The class was so lively that we felt like asking question, seeking clarification which we do not get to see in other classes as it used to be so tense and serious. In madam’s class we get opportunity to interact. (Personal Interview)

The positive experience sensed by Student 7 was also felt by Student 9 when he referred to whole class discussions as very positive:

Ah...for me ah...I felt very positive during a session on *Force*. That class somebody asked question on “push and pull” which drew whole class into discussion and debate. When there is debate and discussion among friends, even though I don’t have knowledge, I get much knowledge from my friends because different people have different perceptions so they elaborate on that particular topic. So, that’s why I can say, I feel positive when the class is very interactive or when debate is going on in the class. (Personal Interview)

Cogens reinforced interview statements by the students; for example, “interactive classes helped to clarify doubts” (S3, Cogen 3) and “I learn from views and opinions shared by other people” (S28, Cogen 7). The tutor also expressed that “learning starts through discussion and interaction” (Cogen 5).

My observations also revealed that whenever there was interaction there was laughter and smiles on the faces of students. Such synchrony in mood and focus
strengthens the assertion that students experienced heightened shared positive emotions and emotional energy when engaged in interactive whole-class discussions.

5.2.4 Assertion 1.4: Formal lectures were associated with negatively valenced emotional climate or decrease in emotional climate.

Many teachers still prefer the lecture as a strategy to establish and sustain order in the class, especially when used as a safety net by beginning teachers who are new to teaching (Peek, Winking, & Peek, 1995). Hussain, Azeem and Shakoor (2011) found grade 10 science students in Pakistan fared better in Physics when engaged through inquiry rather than a lecture. Though I did not study the impact of lectures on EC, I found that excessive use of lectures in the classroom can produce negative EC or low EC. The discussion that follows will add more insight to the study by Hussain et al. (2011) which found that lectures impacts negatively on students’ learning.

As evident from Figure 5.12, all nine lessons dominated by lectures were at or below average EC for all lessons. The maximum EC was only 3.4 observed in lesson 16 (Interval 8) and lesson 20 (Interval 16) and a negative EC of 2.7 was recorded in lesson 22.

Figure 5.12. Mean ratings of emotional climate at three-minute intervals for lecture method.
Video analysis shows in general, lecture classes were not welcomed by students. During lecture sessions the tutor’s interaction routine fell flat. There was a lack of positive emotional energy as the conversations were univocal with students reciprocating with occasional “Yes” or “No” responses or nodding of heads in response to her queries and apparently the interactions faded out quickly. Most of the students were seen dozing openly during lecture sessions. This observation is related to the image captured in Figure 5.13a that shows Student 14 and Student 28 in slumber and Student 3 yawning suggestive of boredom. This observation is consistent with the low EC ratings in Figure 5.12.

![Figure 5.13](image)

*Figure 5.13.* Evidence of lack of mutual focus and emotional energy, S14 and S28 in deep slumber while S3 yawns (a) and Students (S12, and S13) with tired body language (b).

Students remained silent throughout the lectures as the flow of information was one way from the tutor to students. There was a lack of humour as evident from their serious looks and body postures (Figure 5.13a and b). The lack of alignment of body positions indicated a lack of mutual focus amongst students. For instance, Figure 5.13b shows Choenev (S12) and Chhimi (S13) resting their cheeks on their hands. The tired body language of students, absence of humour, and their serious looks reinforces the assertion that lecture dominated classes were associated with negative or low EC.

Students in the interviews also expressed that they hated lecture classes as they were monotonous and less interactive. They used various expressions to describe
lecture-dominated class such as; it puts them to sleep, they feel drowsy, they concentrate less, they become angry, bored, negative, and there is no space for discussion. A representative comment was:

I feel sleepy in a lecture-dominated class because there was no humour, no discussion, only madam was speaking and we were simply listening. Listening for hours, I lose my concentration and not able to understand anything. I found those classes bit dull, nobody was interested, their face shows that they were tired and their mind was somewhere else. A lesson where the tutor simply lectures with no input from the students becomes monotonous and put students to sleep. (Personal Interview, Student 7)

The tutor was also of the view that lecture-dominated classes were not healthy for the students as expressed in cogen 5:

As agreed in the last cogen, not to dominate the class, but I had to as my class got delayed by 15 minutes, so I rushed in order to complete the chapter. I think it is better to encourage students to find their own answer, listen to them and if it is wrong try to correct it. (Cogen 5)

5.2.5 Assertion 1.5: Sessions led by unprepared presenters were associated with negatively valenced emotional climate or decrease in emotional climate.

As discussed earlier the students were required to do a presentation on the given topics and initiate discussions (SCE, 2009). Though students in general appreciated a shift from the tutor dominated classes to student led sessions, in particular they were not happy with sessions led by unprepared presenters.

As indicated in Figure 5.14, the average EC of the two lessons were below the average EC of all lessons. The mean EC rating of 3 in interval 1, lesson 17 is one of the lowest ratings across all lessons.
Figure 5.14. Mean ratings of emotional climate for unprepared student presenters.

One of the incidents of the presenters coming unprepared was reported in lesson 17, interval 1. Samphel, one of the presenters, confessed and sought apology from the tutor and the rest of the students for not having done enough homework to lead the session on Thermal Expansion. His apologetic statement was:

Good afternoon. Ah…today we are (2s) going to start a new chapter… Thermal Expansion chapter nine. Ah…me ... myself and Mr. Surjay will be presenting. To be frank…to be frank… ah… I don’t think both of us ...any one of us are really prepared because we just knew that we had presentation today morning itself. So, I don’t think that we are very prepared, we will try our level best to answer your questions and I hope madam will also be there ah…to (.) accompany us.

Samphel’s body language (body tilted toward his left) and tensed facial expression matched his apology to suggest he was disheartened and sorry for not having come prepared (Figure 5.15). The sentence prefixed and suffixed by word “ah” and use of synonymous word “me...myself” and both of us or “any one of us” indicates his nervousness. Moreover, he stammered twice as he was making his apologetic statement.
The utterance, “So, I don’t think that we are very prepared, we will try our level best to answer your questions and I hope madam will also be there ah…to (.) accompany us” further indicates his lack of confidence to lead the session. Furthermore, the prosody analysis of speech “ah...I don’t think” when compared with a similar neutral utterance “so...I don’t think” from the same lesson confirmed that he was disheartened and felt sorry for not having prepared his presentation. The analysis show decrease in pitch, energy intensity, and speech rate (F₀=156 Hz v 182 Hz; energy in air=77dB v 81dB; speech rate=4/1.05=3.8 syllables/s v 4/.65=6.2 syllables/s) consistent with the emotion of sadness.

![Samphel](image)

*Figure 5.15. Samphel with a disheartened look.*

During interviews students asserted that when a few presenters neither facilitated discussion nor provided adequate explanations, they felt irritated and negative. Student 6, for example, said:

> When our friends do not come prepared for their class presentation and madam had to step in to cover for them I felt bored. For example, in Sungrul’s class he did not speak a word and madam had to take his place and also the class time got extended by 10 minutes as the discussion continued. That time, I felt bored sitting at the back bench in a hot summer day. During that part of the lesson I pressed 1 (very negative) in the keypad. I kept sitting bored and looking at my watch frequently for the class to end. (Personal Interview)
These comments were supported by the tutor, who said “I feel irritated when students come unprepared or seek extensions for their presentations at a later date” (Personal Interview).

5.2.6 Assertion 1.6: Group work activities generated mixed emotional climate.

Group work activity refers to discussion in small groups where students share information and ideas. The number of groups varied from seven with four members each to 14 groups with two members each depending on the types of activities. This activity typically is facilitated by the tutor or the presenter on a given topic who later invites groups to share their findings with the rest of the class followed by further discussion. This is different from laboratory work.

The average EC (3.4) of the intervals which had group activities stood well above the average EC for all lessons (3.2). As reflected in Figure 5.16 within the lessons the intervals where group work commenced generally generated higher positive EC. For instance, the EC was 3.8 in interval 9 of lesson 2 and 3.6 in interval 6 of lesson 4. But as the group work prolonged the EC dropped and some even dropped to negative values as in interval 3 of lesson 5 and interval 5 of lesson 15. But the EC for most lessons remained above the average EC for all lessons indicating that on the whole the group work activity was well received by the students.
Video analysis confirms the earlier claim that group activities in general were well received by the students. For instance, Figure 5.17 shows that as group activities on designing of models commenced in interval 10, lesson 16, Students 21 and 15 got entrained into synchronous laughter following the comment made by one of their group members using hand gestures (face not visible). Similarly, S6 (Figure 5.17) is seen using hands and fingers (gestures) to stress his points while others (S13 and S14) including the tutor are reciprocating with their bodies aligned to each other with elbows joined, thus demonstrating synchrony of action and shared emotions among interaction participants. Student 15 (Figure 5.17) is seen with mouth open and tooth exposed. Creases could also be spotted running down from her nose to the outer edge beyond her lip corners as she interacted with her friends, thus revealing happiness (Ekman & Rosenberg, 2005).
Furthermore as group activities designed to familiarise students with the Grade 9 Physics Syllabus commenced in interval 9 (Lesson 2), there was mutual focus and shared emotion among students (Figure 5.18). For instance, Figure 5.18a shows Student 4 articulating his point with hand gestures while other members (S22, S5, S12, and S1) reciprocating with smiles, gaze fixed on him and bodies facing toward Student 4’s explanation of a point revealing positive emotional arousal. The highest EC of 3.8 for the lesson was recorded during this interval.

On the contrary, video analysis showed that as group work became prolonged, the EC dropped to 3.3 in the next interval (10). Figure 5.18b shows Student 1 fiddling with
sellotape, S22 playing with pen and S11 reading unrelated text indicating a lack of shared mood and emotional entrainment observed previously. Student 1 (Figure 5.18b) turned his attention to group work later when he realised that the camera was being focussed on his group (Researcher’s Diary).

The positive climate recorded in interval 10, lesson 16 was also echoed in interval 11 (Lesson 16) evidenced from Figure 5.19a. Figure 5.19a shows S1 leading a discussion and others (S19, S3, S18, S25, and S9) entrained with laughter generated from the discussion and bodies aligned with each other. The EC for this interval was 3.7, the highest rating for that lesson. Student 18 (Figure 5.19a) is seen with mouth open and tooth exposed revealing happiness (Ekman & Rosenberg, 2005). As the discussion extended into the next interval (i.e., Interval 12) the group synchrony and body entrainment digressed as evident from the body posture of students (S28, S1, S3, and S18) from Figure 5.19b. Figure 5.19b shows students (S28, S1, and S3) staring at a group to their right while S18 is engaged in independent work. The EC dropped to 3.5 in this interval.

Figure 5.19. (a) Evidence of mutual focus and emotional entrainment among students generated during group work. (b) Students involved in disengaging activities.

The EC dropped further down in lessons 5 and 15 during group activity. For instance, when group activity began in lesson 5, interval 2, the EC was 3.2. As the activity prolonged, the EC dropped to 2.9, the lowest EC recorded for that lesson. Similarly the
EC declined to 2.9 in interval 5 from 3.4 in interval 4, lesson 15. The drop in EC is attributed to prolonged discussion as evident from a lack of body entrainment and emotional energy as evident from Figure 5.19b, lesson 16 and interval 12. The student’s level of engagement in the discussion has declined as apparent from S6 sleeping (Figure 5.20a) and S1 yawning in lesson 15 interval 5 (Figure 5.20b) for almost three seconds displaying absence of positive emotional energy. The body positions and gaze of other students also shows low levels of mutual focus and emotional energy.

*Figure 5.20.* Evidence of lack of mutual focus and emotional energy as seen from (a) S6 in deep slumber and (b) S1 yawning.

The students in the interviews and cogens had more positive ideas to share about group activities. Most students described group activity as; lively, positive and interesting and for some it widens their knowledge and develops social skills. For example Student 24 expressed that, “during group work students remain active and enjoy the class. I could see smiles on their faces... I too enjoyed the class as I participated in the discussion and contributed my own share of views and opinions” (Personal Interview).

The above comment was supported by Student 4, when he said, “ah…group activity…when we indulge in interaction, there is more learning besides we develop interpersonal skills. We can also improve English language and I feel that it is a positive aspect of learning” (Cogen 6). The tutor is also appreciative of the students opening up and participating because of group activity, when she expressed, “what I like was
everybody was participating in the discussion. Last year, they were so quiet. They will not open up unless coerced. But today, they have opened up but the girls still need to open up” (Cogen 2).

My observations also confirm that the students participated enthusiastically in group work. There was collective effervescence as members were deeply engrossed working together on a given task but conversely as group work progresses, students shy away from their task since it became monotonous for them to attend to the same task over a period of time.

5.3 Assertion 2: The valence of emotional climate depended on the type of relationship structure present in the classroom.

In the context of this study ‘relationship structure’ refers to a manner in which the tutor and students behave in a social arrangement that make a difference in how connected they feel towards each other and the class and how motivated they feel to accomplish success. The quality of tutor-student relationships often has massive impact on student success at every level. For instance, when tutor-student relationships improve, improvement in students’ classroom behaviour such as reductions in hostility and better compliance with rules are evident (Murray & Pianta, 2007).

The events that led to positive relationship structure in the classroom include humorous moments in the classroom, the teacher supporting students in their work, and violation of classroom rituals led to negative relationship structure. Creation of humour in the classroom and the teacher supporting students’ work valenced the class EC positively through student engagement while violation of rituals has negatively valenced the classroom EC as detailed below.
5.3.1 Assertion 2.1: Humorous events were associated with positive emotional climate.

An ethnographic study using conversational analysis by Roth et al. (2011) in a grade 7 Australian classroom found three fundamental characteristics and functions of laughter in science learning: first, laughter is interactive, as it stems from the actors involved and the type of situation they are in; second, laughter plays a role in both challenging and reaffirming the relationship between knowledge and power and who holds that power; and third, laughter creates intimacy, complicity, and solidarity as a part of the learning environment that fosters engagement and interest. The authors concluded that integrating ‘scientific talk’ with everyday talk serves as an important learning function by both emphasising and overturning the seriousness with which science is usually associated. Laughter plays an important role in mediating classroom processes and the learning that emerges. Although my study did not intend to study laughter, I was able to identify that humour appears integral to learning and understanding science and should not be dismissed as irrelevant to science learning.

Here in the context of this study, humorous moments refer to laughter generated from non-serious talk, jokes, and other aspects of speaking which may be related or irrelevant to the science lessons. In the course of the study period there were seven lessons that comprised humorous moments.

Figure 5.21 displays the EC for lessons associated with humorous moments. Seven of the 16 lessons (i.e., 2, 5, 8, 11, 13, 17, and 20) featured humour. Specifically, highly positive EC was reported in lessons 2 and 13 (i.e., EC=3.9), followed by lessons 8 and 11 (i.e., EC=3.7). The average EC for lessons 5, 17, and 20 were also above the class average for all the lessons.
In this section, I present evidence from three different extracts closely supported by data from cogens, interviews and my researcher diary to support the claim that humorous events were associated with positive EC. The analyses of these three extracts reported higher rates of emotional arousal through overlap of speech, exchange of laughter, and body gestures as the lessons unfolded.

I begin by illustrating how Samphel misunderstood the tutor’s instructions that sent the whole class into laughter generating positive emotional energy as detailed in Extract 5.3. That day students were supposed to read and discuss in groups the handouts on the topic grade 9 Physics Syllabus. The purpose of group discussion was to familiarise the class with grade 9 Physics content, the mode of assessment and references to be used. These students, once they graduate from the college, will have to teach Physics in grade 9 and 10 in a middle secondary school. Since the curriculum in Bhutan is uniform across schools it is advantageous for them to be familiar with the school curriculum and mode of assessment. This is also in response to feedback from
schools to familiarise pre-service teachers with school curriculum while at the college (Rinchen et al., 2011).

Extract 5.3: Humour – Lesson 2, Interval 1.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Tutor</td>
<td>What are you supposed to do? ((Smiling and maintaining eye contact with the students)) group ...ah... (3s) what you are supposed to do?</td>
</tr>
<tr>
<td>02</td>
<td>Samphel &amp; Serpo</td>
<td>We are supposed to ((choral answer))</td>
</tr>
<tr>
<td>03</td>
<td>Tutor</td>
<td>#One at a time#</td>
</tr>
<tr>
<td>04</td>
<td>Students</td>
<td>((giggles))</td>
</tr>
<tr>
<td>05</td>
<td>Tutor</td>
<td>(2s) Yes... yes ((smiling and leaning toward Samphel)) what you are going to do?</td>
</tr>
<tr>
<td>06</td>
<td>Samphel</td>
<td>We are going to read the paper on grade 9 syllabus</td>
</tr>
<tr>
<td>07</td>
<td>Tutor</td>
<td>read the syllabus ((nodding her head in acceptance))</td>
</tr>
<tr>
<td>08</td>
<td>Samphel</td>
<td>and then find what to do?</td>
</tr>
<tr>
<td>09</td>
<td>Students</td>
<td>((whole class and the tutor broke into laughter))</td>
</tr>
<tr>
<td>10</td>
<td>Tutor</td>
<td>He is saying, he will read the paper and find out what he will do. That we know everything is here ((tutor pointing to the handouts)) but you have to tell us what you are supposed to do in groups ((smiling)).</td>
</tr>
<tr>
<td>11</td>
<td>Students</td>
<td>((The whole class broke into laughter))</td>
</tr>
</tbody>
</table>

As usual to confirm whether the students were aware of the assigned group task the tutor asked a question of the students, “what are you supposed to do?” in turn 01. The tutor maintained eye contact with the class smiling as she paused for (3s). Samphel and Serpo broke the silence by responding in chorus in turn 02. The tutor intervened and asked one person to speak at a time (03). Other students found that moment quite humorous and started giggling in turn 04. The tutor encouraged Samphel to respond with her body leaned toward him, smiling and prompting him to speak in turns 05 and 07. Samphel’s lack of understanding of the instructions and funny answer sends the tutor (Figure 5.22a) and the whole class (Figure 5.22b) laughing in turn 09. Furthermore, the tutor’s remark in turn 10 broke the whole class into laughter. eMotion software shows that the suspected emotion of the tutor (09) was happiness as described earlier (Ekman, 2003; Ekman & Rosenberg, 2005). The same features were also spotted
on the face of Student 19. Moreover, the EC for that interval was rated at 3.9 the highest rating for that class.

![Figure 5.22. Evidence of emotional energy: Tutor and S19 (a) and Students S6, S2 and S22 laughing following the humorous response given by S28.](image)

Prosodic analysis of words “yes” in turn 05 and “everything” in turn 10 further suggests that the tutor was excited as she converted the serious tone of the class into humorous moments. For instance, the analyses of the word “yes” in turn 05 ($F_o=199\text{Hz} \text{ v } 196\text{Hz}$; energy intensity=$76\text{dB} \text{ v } 69\text{dB}$; speech rate=$5.57$ syllables/s v $1.12$ syllables/s) when compared with less emotionally charged utterance “yes” in interval 5, lesson 2 and the word “everything” in turn 10 ($F_o=303\text{Hz} \text{ v } 271\text{Hz}$; energy intensity=$82\text{dB} \text{ v } 78\text{dB}$; bandwidth $B1=264\text{Hz} \text{ v } 39\text{Hz}$) when compared with similar but less emotionally charged utterance “everything” from lesson 2, interval 8 show characteristics consistent with happiness.

Two weeks later, during the wrap up session on *Experiments and Measurement*, lesson 5, interval 16 (see Extract 5.4), Samdrup appeared at the door interrupting the session (01). All the students stared at him laughing as it was quite funny to see him coming to the class two minutes before the closure of the session. The laughter of his friends did not deter him as he sought permission (e.g., *May I come in madam*) from the tutor to enter the classroom in turn 03. In the Bhutanese context students must seek consent from the concerned tutor to exit or enter a class that is in progress. The tutor
turned around to face Samdrup and said “Yes, come in”. To make Samdrup feel at ease the tutor created humour in turn 04 by saying “you are too early for the class” smiling (see Figure 5.23). The pause of (1s) suggests she was looking for an appropriate word to make it sound more humorous and not hurt him. Following her remark the whole class broke into laughter thus generating emotional energy in turn 05.

Extract 5.4: Humour – Lesson 5, Interval 16.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Samdrup</td>
<td>Standing at the door. May I come in madam ()</td>
</tr>
<tr>
<td>02</td>
<td>Students</td>
<td>((Staring at the door smiling and laughing))</td>
</tr>
<tr>
<td>03</td>
<td>Samdrup</td>
<td>May I come in, madam</td>
</tr>
<tr>
<td>04</td>
<td>Tutor</td>
<td>Yes, come in. You are too early for the (1s) ah...class...he...he... ((Smiles))</td>
</tr>
<tr>
<td>05</td>
<td>Students</td>
<td>((The whole class broke into laughter))</td>
</tr>
</tbody>
</table>

*Figure 5.23. Tutor creating humour in the class.*

The analysis of the tutor’s facial expression when she uttered the sentence “Yes, come in. You are too early for the class” is consistent with the expression of happiness (Ekman, 2003; Ekman & Rosenberg, 2005). Furthermore, the prosody analysis of words “yes” and “come in” confirms the identified emotion. For instance, there is a rise in pitch, energy intensity and speech rate for both the utterances [(F_o=244Hz v 198Hz; energy intensity=81dB v 69dB; speech rate=3.03 syllables/s v 0.50 syllables/s); (F_o=278Hz v 266Hz; energy intensity=80dB v 77dB; speech rate=2.8 syllables/s v 1.87 syllables/s)] when compared with neutral utterances from the same lesson. Evidence in past studies (e.g., Roth et al., 2011) consistently suggests that the use of humour
improves classroom climate, increases student-teacher rapport and reduces tension (Provine, 2002) and thus encourages students to report to classes even if they are late for class.

Another humorous event was experienced in lesson 17, interval 13 as detailed in Extract 5.5. Shabdung raised a very good and relevant question in turn 01. Samphel shared his perspectives on the question raised in turn 02. In order to make it more relevant, the tutor used everyday examples to explain the concept in turn 03.

Extract 5.5: Humour – Lesson 17, Interval 13.

<table>
<thead>
<tr>
<th>Turn</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Shabdung</td>
<td>If I heat a… a metal for a longer duration, do you think the metal will keep expanding for the entire duration of heating?</td>
</tr>
<tr>
<td>02</td>
<td>Samphel</td>
<td>Every… every metal… every material that you find in this world have a limit or critical point where by it cannot expand. For example glass, if you heat it more after reaching the critical point, it will break. Everything has its critical point.</td>
</tr>
<tr>
<td>03</td>
<td>Tutor</td>
<td>(3s) How many of you (1s) have open the jam jar (2s) Jam, J…A…M ((spelling out)) bread and jam. How do you open?</td>
</tr>
<tr>
<td>04</td>
<td>Student 24</td>
<td>We rotate the lid of jam.</td>
</tr>
<tr>
<td>05</td>
<td>Student 2</td>
<td>We pull with hand</td>
</tr>
<tr>
<td>06</td>
<td>Students</td>
<td>((The whole class broke into laughter))</td>
</tr>
<tr>
<td>07</td>
<td>Tutor</td>
<td>Girls…girls ((smiling))</td>
</tr>
<tr>
<td>08</td>
<td>Student 9</td>
<td>They cannot open</td>
</tr>
<tr>
<td>09</td>
<td>Student 5</td>
<td>By turning the lid of jam () ((smiling and using hand gesture))</td>
</tr>
<tr>
<td>10</td>
<td>Student 18</td>
<td>Girls cannot open madam</td>
</tr>
<tr>
<td>11</td>
<td>Student 24</td>
<td>Girls cannot open madam</td>
</tr>
<tr>
<td>12</td>
<td>Students</td>
<td>((laughter))</td>
</tr>
<tr>
<td>13</td>
<td>Tutor</td>
<td>OK, that means you all have strength (.). Shh… ((putting fingers against her lips as the class was getting noisy)) (1s) Now (.), If you find it very difficult to open the jam jar, what you have do is, you light a candle and heat lid of jam jar it will come off easily. You don’t have to apply the same force. I know some of you must be catching the bottle, some pulling and some twisting, etc. In the process the jar must be breaking ((tutor demonstrating and smiling))</td>
</tr>
<tr>
<td>14</td>
<td>Student</td>
<td>force</td>
</tr>
<tr>
<td>15</td>
<td>Student</td>
<td>((The whole class broke into laughter))</td>
</tr>
<tr>
<td>16</td>
<td>Tutor</td>
<td>You don’t have to do all these. What</td>
</tr>
</tbody>
</table>
you have to do is heat because the lid is made up of metal and metals expand on heating. As it expands you open it. You don’t have to cool it. It will cool itself as time passes.

The student’s crude method of opening the jam jar (turns 04 and 05) and boys picking on girls (08-11) led to humorous moments as evident from students laughing in turn 12. The tutor realising that the boys are being hard on the girls, she deviated the topic in turn 13 and suggested an easy way of opening a jam jar. She cautioned them to refrain from pulling and twisting the lid as it might break the jam jar and harm them in turn 13. For instance, Figure 5.24a shows the tutor gesturing how students typically open a jam jar while at the same time smiling and leaning forward. Students (S5, S21, S20, S12, S9 and rest not visible) are seen entrained towards the tutor’s demonstration on how students usually open a jam jar and they are laughing indicating presence of mutual focus and emotional energy (Figure 5.24b).

More specifically when the prosodic characteristics of the words “open the jam jar” in turn 13 when compared with the less emotionally charged utterance “open the jam jar” in turn 03, there was a rise in pitch, energy intensity, and speech rate ($F_0=249$Hz v 175Hz; energy intensity=80dB v 79dB; speech rate=3.5 syllables/s v 2.4 syllables/s) consistent with the results for high intensity emotions. The humorous interactions continued after turn 16.
So that’s all, because We can also open beer madam

OH...NO...NO. For beer please don’t do that (folding her hands and requesting students not to do that). For beer we have other way of doing it (hand gesture).

In case if there is no opener... (hand gesture)

if there is no opener

Oh, if there is no opener, please in the case of beer do not heat, there is a great chance that it might burst because beer has carbonated gas (student’s giggles). The gas might expand and burst. I don’t want to hear from you that madam Pelmo told us, if you cannot open, heat it. So don’t do that.

We can open with mouth madam.

We can open using mouth

Mouth (surprise look))

(Girls broke into laughter)

Now these are drill and practice. Through drill and practice even animal can. But please do not do that.

In turn 17 (above), the tutor wants to close the discussion when she said “so that’s all”. Student 9 extended the interaction when he said we can open a beer bottle by heating it in turn 18. The tutor pleaded with students with folded hands smiling (Figure 5.25) not to heat beer bottles as it might burst in turns 19-23. Her utterance of “Oh...no...no... for beer please don’t do that” in turn 19 indicates her concern for the students. Moreover, her facial expressions at that time were consistent with happiness [see Figure 5.25] (Ekman, 2003; Ekman & Rosenberg, 2005). Further the prosody analysis of speech parameters with increase in energy intensity and decrease in bandwidth (energy intensity=82dB v 80dB; B1=386Hz v 503Hz) for “please don’t do that” and increase in pitch, energy intensity, and decrease in bandwidth for “burst” (F0=283Hz v 225Hz; energy intensity=80dB v 76dB; B1=137Hz v 334Hz) when compared with similar utterances “So don’t do that” and “burst” from the same lesson 17 and interval 13 confirms the above positive emotional arousal.
Samphel provided another alternative for opening beer bottles in turn 24 supported by Student 28 indicating synchrony. The tutor responded with a surprised look in turn 26 which sent all of the girls laughing in turn 27 generating positive emotional energy.

Figure 5.25. Production of emotional energy.

The positive emotions experienced above were also echoed by most students in interviews and cogens. The students uttered that humour sets their mood for the class besides helping them to gain attention and make classes lively and fun. For instance, Student 7 expressed:

As a student we always like our teachers to be jolly and humorous. I don’t mean that she should be joking all the time but sometime she should share relevant anecdotes and incidents to lighten up the mood of the students as she does. Relevant jokes help students to gain their attention and bring their mind back to the class. We feel happy and excited in a class where the teacher is jolly and humorous. I can also see smiles on the faces of my friends in such classes which mean they are also enjoying the class. (Personal Interview)

This observation was supported by Student 10, who said:

To make class interesting there should be humour. I remember in one class madam had explained a particular concept by narrating a story about a boy throwing apple from the window to his girlfriend. That was good humour created and I felt very positive in that class. (Cogen 5)
The tutor was also of the view that it was good to create humour in between the sessions when she expressed “students usually expect you to create jokes in the class in between your teaching. So I always think of analogies and incidents relevant to the lesson at hand to develop interest in students and reflect back” (Cogen 1).

5.3.2 Assertion 2.2: Positive emotional climate was evident when the tutor supported students in class work.

Figure 5.26 displays the EC for lessons associated with the tutor supporting students’ work. The EC for all the seven lessons (i.e., L8, L13, L15, L16, L20, L22, and L23) were positive. Specifically, highly positive EC was reported in lessons 16 (Interval 10), 20 (Interval 11) and 23 (Intervals 11 and 15).

![EC for tutor supporting students' work](image)

*Figure 5.26. Mean ratings of emotional climate at three-minute intervals for tutor supporting students’ work.*

One positive aspect of this study was the professional relationships that developed between students and the tutor, and more so with the tutor and presenters. The presenters were required to come prepared to initiate discussions in the class. The tutor stepped in whenever there were controversial issues or presenters failed to provide appropriate solutions to the queries from the students. That way there was mutual focus
and team spirit between presenters and the tutor. Moreover, other students too showed collective responsibility by volunteering to help clarify ideas when the tutor and presenters failed to do so.

Collegiality between students and the tutor helped enhance their working relations. For instance, when the presenters were not able to answer questions posed by students, the tutor stepped in and at times they jointly clarified their doubts. For instance, Figure 5.27a shows the tutor and presenter helping each other to explain a question raised by others. The body posture of the presenter and tutor aligned towards each other, eye contact, smiles on their faces, and the hand gesture while making a point indicates that the emotion was positively valenced. A similar emotion was expressed in Figure 5.27b, lesson 23, interval 11 when the tutor helped students (S18, S8, S3, S14, and S12) to fix their group work. The EC was recorded at 3.8 the highest for the class. This was clear evidence of positive emotional energy among students and the tutor.

Figure 5.27. (a) Tutor and S26 in deep consultation. (b) The tutor helping students (S18, S8, S3, S14, and S12) with their work, body aligned towards each other and smiling evidenced of shared focus and positive emotional arousal.

Extract 5.6: Tutor Supporting Students’ Work – Lesson 15, Interval 8.

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>01</td>
<td>Choeden</td>
<td>What is the effect of centre of gravity on animate and inanimate object?</td>
</tr>
<tr>
<td>02</td>
<td>Singey</td>
<td>(28s) ((after discussing with the tutor and other colleague presenter)) If I define animate and inanimate object...</td>
</tr>
<tr>
<td>03</td>
<td>Student</td>
<td>((murmuring))</td>
</tr>
<tr>
<td>04</td>
<td>Tutor</td>
<td>ask them to be silent by show of hands</td>
</tr>
</tbody>
</table>
Singey: (3s) animate object is ah... living things and inanimate are non-living things. (3s) so can you think of how gravity effects living and non-living things. Anybody has views on this...

Tutor: ((tutor intervened). We know everybody has centre of gravity. You, me, pen, everything on the earth. But inanimate object cannot shift centre of gravity by itself. Human (animate object) body can shift our centre gravity. What do we do when we lift heavy objects?

Student: We change our body posture.

Tutor: Yes; we change our body posture by stretching legs, bending and kneeling down, whereas non-living object cannot do it by themselves. ((the tutor was very articulate and full of gestures))

The analysis of the excerpt above from the lesson 15, interval 8, in Extract 5.6 reveals team spirit and shared emotion between the presenter (Singey) and the tutor as they collectively responded to the question raised by Choeden in turn 01. The long pause of 28s was the time the tutor and Singey spent to discuss in turn 02. The tutor helped Singey to calm the students down (turn 04) who went haywire because of the long discussion between Singey and the tutor in turn 02 by asking them to remain silent by a show of hands. The tutor further supplemented Singey’s explanation in turn 06 (Figure 5.28). The tutor was found to be very articulate using a lot of gestures while expressing her views.

Figure 5.28. Tutor acknowledging Singey’s response by hand gesture, evidence of mutual focus and shared emotion between the tutor and Singey (presenter).
Another example of positive emotional arousal was also echoed in lesson 20, interval 11 in Extract 5.7. The EC rating for this interval was 3.6. Extract 5.7 details the classroom interaction with the tutor facilitating the discussion through prompts and redirections. The tutor opens the discussion (02) by confirming from the presenter (Serchung) whether he had understood Singey’s question asked in turn 01. Her tone and her body gesture as she was talking to Serchung suggest her concern for him and her interest to the ensuing discussion.

Extract 5.7: Tutor Supporting Students’ Work – Lesson 20, Interval 11.

01 Singey ((Stood up)) I have two questions. The first one is why does light reflect? and the second one is we say moon reflects the light of the sun (. and my doubt is; is sun coated with silver to reflect the light? ((smiles))
02 Tutor (3s) You got the question ((turning to Serchung))…
03 Student 27 light reflects…
04 Tutor Why light [reflects]
05 Students |reflects|
06 Tutor (4s) Why light reflects?
07 Serchung (3s) Light reflects because of reflecting subject ((covered his face in his palm and corrects)) reflecting object. Since there is reflecting surface then only the light reflects.
08 Tutor Reflect yeah…
09 Serchung If there is no reflecting surface then the light will not reflect.
10 Tutor The light reflects only if surface is a reflector of light. Otherwise there is no chance of getting light reflected back.
11 Student 27 Then, examples of those substances which are not reflected back.
12 Tutor example of …
13 Student 9 Non example of reflecting surface
14 Tutor Non example of reflecting surface you can say ((directing to Serchung)) Translucent, (. ) glass slab.
15 Student 24 sand
16 Student 4 glass

The tutor’s pause of 3s in turn 02 indicates her hesitation to confirm the question from Serchung as this might embarrass him. Student 27 completed the tutor’s sentence (02-
and overlapping speech in turns 04 and 05 illustrates synchrony between the tutor and students. The tutor reiterated the question in turn 06 which Serchung after a long pause, tried to answer hesitantly in turn 07. The tutor reinforced Serchung’s answer in turns 8 and 10 indicating mutual focus and group synchrony. Other students joined the tutor to help Serchung with non-examples of reflecting surface in turns 12–16 when Serchung and the tutor ran out of points indicating mutual focus and group synchrony.

The conversation analysis in extract 5.8 shows that the tutor alerts the class when the interaction fades by reiterating what is expressed by the preceding speaker while she maintains her eye contact with the students as discussed below:

Extract 5.8: Tutor Supporting Students’ Work – Lesson 22, Interval 12.

01 Choeden Why is the filament of a bulb gets red hot when heated where as connecting wires does not?
02 Sangay This is mainly due to ah…resistance of the filament of the bulb. The resistance of the bulb is very high where it can get hotter like for example in the heater, the heater wires are made up of metal what to say ah…can you refer to class eight textbook ((turning to his friends at the right)) is made up of high resistance wires that is why it is becoming hot, but the connecting wires did not get hot, that is the reason. ((Sangay was quite expressive and articulate with all hand gestures))
03 S5, S27, S13 & other students ((staring at Sangay smiling))
04 Tutor Do you understand? ((Maintaining eye contact with the students)) Sangay is explaining that the filament of the bulb has high resistance that is why it resists so much. So it glows whereas connecting wires have less resistance, so it let current pass easily. In the earlier video, it showed that, actually the bulb does not provide resistance it is the filament which provide resistance. So it gets heated up and gives (1s) light or glows. ((Tutor intervenes and supplements Sangay’s point—shows support))
05 Students ((Staring at the tutor with smiles))
06 Sangay ((scratching his head and referring to a book)). It is like this madam, (3s) ah…the reason is like this…a good conductor like copper and aluminium have low resistance and a poor conductor like nichrome and tungsten have high resistance, this is the reason why nichrome wire is used as a heater coil turns red hot whereas electrical cable remains cold.
07 Students ((staring at Sangay wearing smiles on their faces))
As Sangay who led the session put forth his views (turn 02) on the question posed by Choeden in (01), he was quite expressive and articulate with body movements and hand gestures. The positive emotional cues that he displayed through his bodily gestures were reciprocated by his fellow friends in turn 03 through their eye contact and return smiles generating mutual focus and shared energy amongst them (Figure 5.29). In turn 4, the tutor showed her regard for Sangay’s perspectives by reiterating what he has expressed in turn 02 illustrating synchrony and support. More specifically when the prosodic characteristics of the word “glows” uttered by the tutor in turn 04 were compared with the word “glows” less emotionally charged utterance, in turn 04 from the same lesson, the energy intensity and speech rate was (82dB v 79dB) and (1.41 syllable/s v 0.81 syllable/s), respectively showing consistent results for high intensity emotions.

![Figure 5.29. Evidence of mutual focus and emotional entrainment between Sangay (presenter) and fellow students (S27, S5, and S13).](image)

Similarly, prosodic analysis of speech parameters for the utterance “the filament” show higher measurement of pitch, formant, speech rate, and energy intensity (F0=282Hz v 276Hz; F1=686Hz v 603Hz; speech rate=5.3 syllables/s v 2.7 syllables/s; energy intensity =81dB v 81dB) when compared with neutral utterance “the filament” from the same lesson (22) and interval (12). The tutor and Sangay supporting each other’s views (04 and 06) indicate synchrony and mutual focus.
The positive climate experienced in the video images and conversational analyses were also captured in interviews and cogens. For instance, the tutor in her interview described this exercise of supporting student work as very enriching and effective for them as they learn from each other. The tutor also felt it as intellectual sharing rather than the tutor teaching and students passively receiving (Personal Interview).

This perception was supported by Student 8, who said:

> So in my view, I would say that I am very happy about the way the tutor helped students in their work. There are times when the tutor also fails to provide answer to certain questions that time she seeks views of other students and collectively solve problems. (Personal Interview)

The positive climate sensed by Student 8 was also echoed by Student 21 when he referred to lesson 8 on the topic *Density* where the tutor and presenter helped each other and collectively solved a particular question, as expressed below:

> Yesterday’s class on the topic *Density* was ah…very interactive class. There was a good team work between the presenter and tutor in solving problems. When doubts are there from the students, the presenter and tutor discussed and collaboratively solved the doubts. (Cogen 4)

### 5.3.3 Assertion 2.3: Negatively valenced emotional climate or decrease in EC was associated with ritual violations.

Collins’s (2004) theory suggests that the co-presence of the teacher and students in the class, students’ willingness to participate, and participants adhering to the group norms are a condition necessary for the establishment of Interactional Ritual Chains associated with positive emotional energy. Whereas the violation of rituals such as students’ interruptions to the flow of the lesson, students being denied opportunities to participate in the classroom activities, the tutor failing to meet academic needs of the students, and the tutor not showing up to the class leads to negative emotional arousals or decrease in EC as discussed below.
5.3.3.1 Students’ Interruptions

In the context of this study, interruptions refer to student behaviours such as reporting late to the class, responding to a question in chorus, and gossiping or dozing in the class which affects classroom activities directly or indirectly. Figure 5.30 shows students interrupted the flow of lesson in lessons (L2, L4, L5, L13, L17, L18, L20, and L22). Three lessons (L2, Interval 8; L5, Interval 1; and L22, Interval 16) had means below the average mean (3.2), three lessons (L4, Interval 1 and 2; L18, Interval 16; and L20, Interval 17) had means at par with the average mean and the rest of the lessons had means slightly above the average mean. On the whole the EC for all the lessons remained low with an average EC of 3.2. The mean EC ranged from 3 to 3.5 as shown in Figure 5.30.

![EC for students' interruptions to classroom activities](image)

*Figure 5.30. Mean ratings of emotional climate at three-minute intervals for students’ interruptions to class activities.*

Choki disrupted the flow of the lesson by reporting late to the class in interval 1, lesson 5. This incident annoyed the tutor as manifested through her hard stare and lips pressed firmly together with corners straight. The upper eyelid is raised indicating anger
(Ekman, 2003; Ekman & Rosenberg, 2005) [Figure 5.31]. The mean EC was recorded at 3 during this interval.

Figure 5.31. Tutor staring at Choki as she interrupts the lesson by coming late.

Though students prefer to give choral responses as it gives them confidence to speak their views, the tutor see it as a disruption to the flow of the lesson as detailed in the conversation analysis of Extract 5.9 from lesson 13, interval 10.

Extract 5.9: Chorus answer – Lesson 13, Interval 10.

<table>
<thead>
<tr>
<th>Turn</th>
<th>Speaker</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Singey</td>
<td>What type of (2s) force is actually acting on a moving fan?</td>
</tr>
<tr>
<td>02</td>
<td>Tutor</td>
<td>Moving fan () ((signalling to the presenter with hand gesture))</td>
</tr>
<tr>
<td>03</td>
<td>Sithup</td>
<td>(4s) I think a rotational force ((smiles))</td>
</tr>
<tr>
<td>04</td>
<td>Sithup</td>
<td>Turning forces are applied</td>
</tr>
<tr>
<td>05</td>
<td>Choki</td>
<td>[Turning force]</td>
</tr>
<tr>
<td>06</td>
<td>Singey</td>
<td>Then what that is called?</td>
</tr>
<tr>
<td>07</td>
<td>Samphel</td>
<td>electricity</td>
</tr>
<tr>
<td>08</td>
<td>Sangay</td>
<td>electricity</td>
</tr>
<tr>
<td>09</td>
<td>Sergyal</td>
<td>[electricity]</td>
</tr>
<tr>
<td>10</td>
<td>Shabdung</td>
<td>[Electricity] are ()</td>
</tr>
<tr>
<td>11</td>
<td>Students</td>
<td>((Speaking at the same time–choral answer))</td>
</tr>
<tr>
<td>12</td>
<td>Tutor</td>
<td>One at a time (staring at the students)</td>
</tr>
</tbody>
</table>

As conversations developed between the tutor and students in pursuit of answering a question posed by Singey in turn 01, the flow of the interactions was disrupted by students giving choral answers in turns 04–11. The tutor warned them to speak “one at a time” in turn 12. This is evident from her facial expression (Figure 5.32); her eyes
giving a hard stare, lips firmly pressed together with corners straight, nostrils dilated and hands clapping to draw attention when she uttered “one at a time” (Ekman & Rosenberg, 2005). Further, the prosody analysis of the speech “one at a time” (energy intensity=81dB v 64dB) shows an increase in energy intensity when compared with similar utterances “one at a time” from lesson 2. This confirms the prevalence of the negative emotion anger.

This inference was supported by Student 1 in a cogen who expressed:

> From my perspective, it is not good to give choral answer because the class gets noisy and it is confusing both for the tutor and students as we don’t know who is giving answer and what he or she is saying. The tutor should ensure that students raise their hands if they want to answer or the tutor should point to students to answer rather than letting everybody speak at the same time. (Cogen 1)

The negative climate was also echoed during the last leg of the lesson in interval 16, lesson 18 when the tutor spotted a few students sleeping in class. Her cheeks were raised with mouth open with upper lip raised, nose wrinkled and hands clutched together (Ekman, 2003; Ekman & Rosenberg, 2005) and she uttered “You are all sleeping” (Figure 5.33a). Further, she threw both her hands sideways gesturing students to get up and she asked them to stretch their hands to get rid of their sleep (Figure
This comment related to the images captured in Figures 5.33a and b showing that the tutor was disgusted.

Figure 5.33. (a) Tutor with cheek raised, mouth open, teeth partially exposed and wrinkled nose. (b) Hands throwing sideways asking students to rise up, evidence of the tutor getting disgusted.

5.3.3.2 Denial of students’ participation in the classroom activities

With regard to this study, the tutor was discouraging students from participation. In such a way, she was denying students the opportunity to share their views or participate in class activities. During this study period there were three lessons where the tutor discouraged students from participating in the classroom activities. Figure 5.34 presents the EC for the class when the tutor discouraged students from participating in the classroom activities for lessons 5, 8, and 20. The average EC (3.1) for three lessons was below the mean EC for all lessons (3.2). The EC ranged from 2.9 in lesson 5 to a maximum of 3.3 in lesson 8.
Figure 5.34. Mean ratings of emotional climate at three-minute intervals for the tutor discouraging students from participation.

One of the events that led to the arousal of negatively valenced emotions was when the tutor discouraged or ignored students from participating in the class. The event in interval 14, lesson 20 shows a drop in the mean of the class EC to 3.2, one of the lowest in that class. In interval 14, Chencho (Figure 5.35a) raised her hand to share her views but the tutor failed to notice her. In the earlier lesson, the tutor also failed to involve Samphel who volunteered to participate in the discussion (Figure 5.35b). My diary note testifies the denial that “the other negative aspect of the tutor was she often unconsciously denies opportunities or shuts down students’ enthusiasm by depriving them from participating in the class.”

Figure 5.35. Chencho (a) and Samphel (b) with raised hand.
The tutor was ignoring students consciously and unconsciously in the classroom which may have a consequence such as students shying away from the future classroom participation or responding in retaliation leading to negative emotional arousal as detailed in Extract 5.10 below:

Extract 5.10: Discouraging Students from Participation – Lesson 20, Interval 14.

01 Sither When a light is passed from denser medium to rare medium the refracted ray will bend towards the normal.
05 Sagar ((Stood up)) His question falls under light madam and we are currently discussing about mirrors.
06 Students ((The whole class broke into laughter))
07 Tutor I know why you are asking this question because the presenter showed video clips on refraction that is why the question has come not because it is relevant to what we are discussing now.
08 Sither but it is important I mean [important know] madam.
09 Tutor [Yes, it is important]. What is your question?
10 Sither I will write it on the board?
11 Tutor Yeah...yeah...yeah you can write. ((tutor wearing a serious look, Sither walks toward board to write question on the board)). (9s) yes, in the meantime when he is writing his question on the board you can ask your question.
12 Samphel ((raise his hand and stood up))
13 Tutor ask your question ((pointing to Samphel))
14 Samphel ah...((Shabdung too stood up behind))
15 Tutor Behind you one is there you can give chance to him.
16 Students ((Friends laughed))
17 Tutor Is it fine? ((Samphel quietly sat down wearing a sad look))

Sither posed a question in turn 01 which was denied by Sagar (presenter) on the ground that the question was not relevant to the topic being discussed in turn 05. The whole class broke into laughter which embarrassed Sither (06). The tutor too denied his question on the same ground to which Sither retaliated in turn 08 saying “this question is important.” The overlapping speech in turns 08-09 and the body position of the tutor and Sither and hand gestures indicate arguments that took place between the tutor and
Sither (Figure 5.36a). The repeated utterance of yeah...yeah...yeah in turn 11 also indicates the tutor’s displeasure for Sither from raising that irrelevant question.

Samphel was also denied an opportunity to respond to a question in turn 15 which upset him. For instance, Figure 5.36b shows Samphel with a saddened look when he was shown a seat and the chance was given to Shabdung (S8) to speak. Figure 5.36b shows Samphel turning away from his two friends (S18 and S24) who were laughing at him after he was denied the opportunity to speak.

![Figure 5.36](image)

*Figure 5.36.* Tutor and Sither (a) arguing with body directed towards each other using hand gesture. Samphel (b) wearing a sad look while his friends (S18 and S24) laughed at him.

Samphel was contacted for an interview later, and he expressed his sadness for denying the opportunity to students to participate in the classroom:

> Usually I am very participative. When I wanted to share something and when opportunities are not given then I feel sad and dull. I like interacting and when I am not given chance to interact I feel I am not learning at all. (Personal Interview)

The above incidents were clear evidence of spontaneous negative emotional energy among students.

**5.3.3.3 The tutor not meeting academic needs of the students**

In the context of this study “content knowledge” refers to an in-depth knowledge expected of any teacher in the discipline he or she is teaching. Pelmo (tutor) is a Physics
lecturer and was teaching Physics Education II to the pre-service teachers during this study.

Another activity that de-motivated students in the class was when the tutor failed to respond to questions raised by students or clarify doubts that emerged during discussions or interactions. Figure 5.37 reports the tutor’s failure to respond to the questions raised by the students in 8 lessons (i.e., L4, L8, L11, L13, L15, L17, L20, and L22). The mean EC ratings of the class were relatively low. The average EC ranged from 3.1–3.5 across the lesson. Though the EC values of some of the intervals (3.5 in interval 9, lesson 8 and interval 13, lesson 20) are the same as those for some of the positive lessons, the overall EC averages (3.3) of intervals (lessons) where the tutor and presenters failed to fulfill students’ academic needs is lower than the overall EC averages of positive lessons (intervals) such as video assisted activities (3.6), model assisted activities (3.5), interactive whole class discussion (3.5), humour (3.7) and the tutor supporting students’ work (3.5). The low average mean of the class is perhaps the repercussion of the tutor not being able to fulfil students’ academic needs.

![Figure 5.37](image_url)

*Figure 5.37. Mean ratings of emotional climate at three-minute intervals for the tutor not fulfilling students’ academic needs.*
The conversational analysis of the proceedings of various classes also indicates that on various occasions the tutor and presenters failed to provide appropriate responses to students’ questions. Conversational analysis of Extract 5.11, lesson 8, interval 9 and a study of her facial expression shows the tutor feeling disgusted for failing to answer a particular question thus revealing her lack of knowledge (Figure 5.38).

Extract 5.11: The tutor not fulfilling students’ academic needs - Lesson 8, Interval 9.

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<table>
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<tr>
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<tbody>
<tr>
<td>01</td>
<td>Singey</td>
<td>Why do we have to teach to students a topic like density?</td>
</tr>
<tr>
<td>02</td>
<td>Tutor</td>
<td>(7s) after consulting with Chencho (student presenter) uh...(3s) I think we don’t have concrete answer. You need to look into the book</td>
</tr>
<tr>
<td>03</td>
<td>Student</td>
<td>Homework</td>
</tr>
<tr>
<td>04</td>
<td>Tutor</td>
<td>Yes, as a home work because what we are saying is from our day to day experiences. Do a Google™ search on why do we need to teach density to students, you will get reasons beyond what we are saying? Is it OK?</td>
</tr>
</tbody>
</table>

The tutor and the presenter failed to respond to a question posed by Singey in turn 01. The tutor and presenter after a deep (7s) consultation admitted that they did not have a concrete answers and students need to do a Google™ search in turns 2 and 4. The tutor’s pause of (3s) in turn 2 before declaring “we don’t have answer” indicates her negative feelings for failing to provide an appropriate response as evident from her facial expression (Figure 5.38) with her cheek raised, upper lip raised and nose wrinkled confirming disgust (Ekman & Rosenberg, 2005).
The experiences that led to low EC in the classroom are also echoed in interviews, cogens and the researcher’s diary. Most students (65%) in the interview expressed that most of the time the tutor and presenters failed to draw conclusions or provide solutions to questions and asked students to do further searches with no follow up later. As a result students are discouraged and lose trust in the tutor as Student 7 remonstrated:

Other negative aspect about madam is when she is not able to answer, she ignore us. Whenever there is presentation by students and most of the questions which the student presenter could not answer are put to madam and most of the time she says “I don’t know”. Whenever, I hear this word, I lose trust in madam and we don’t feel like asking further questions. (Personal Interview)

This comment was supported by the tutor, who said, “Umm… sometimes I am not happy and get sad as I feel students should not be left in dilemma and it is my duty to answer their questions or clarify their doubts” (Cogen 6).

An extract from my diary testifies the tutor’s lack of content:

Whenever the teacher fails to provide concrete answer, she declares “I don’t know” or “I have no idea” please take as a home work and do some net searching. There is no follow up of the discussion later. Her response to a particular question “is there a relationship between frequency and mass” was quite discouraging for the students as she said “from my side there is no relation” may be at the advanced level.” (Researcher’s Diary)
5.3.3.4 Tutor not showing up to the class

Another lesson that generated negative emotional arousal among students was when the tutor did not turn up for a particular class (Lesson 21). The mean EC for that class was recorded at 2.9 the lowest mean across all lessons. That day Sangay was supposed to lead the class, so prior to the arrival of his friends and the researcher he had set his power point presentation.

The data reported in Figure 5.39 reveals that the average EC was negatively valenced (2.9) for the lesson where the tutor did not turn up for the class. The lowest EC value of 2.7 across all the lessons during the study were recorded in this lesson in intervals 8, 11, and 13. In particular, negative EC was reported in intervals (6–11 and 13). The EC for intervals (2–3) were slightly above the average EC. The EC remained flat in the first 3–4 intervals as the students were getting ready for the class and the presentation. As the wait for the tutor prolonged the EC dropped to negative from interval 6.

Figure 5.39. Mean ratings of emotional climate at three-minute intervals for the tutor not showing up to the class.
When the tutor did not turn up to class, Sangay (presenter) became anxious, so we tried to contact her but she could not be contacted. Sangay was upset as he put in so much of effort in preparation for this class and moreover, he had to do it again in the next class.

Sangay expressed his sadness during the interview that:

I felt sad as even after waiting for long, madam did not turn up. I went twice to madam’s cubicle to look for her but her room was locked. Moreover, I didn’t want my presentation to get postponed to the next class as next class means another hassle having to prepare, set projector for PowerPoint presentation beside we are almost to the end of semester and we have to prepare for the exam and meet assignment deadlines. (Personal Interview)

As their wait for the tutor prolonged, students became restless and started to get disengaged. For instance, Figure 5.40b shows students engaged in different activities in interval 7 such as S3 explaining something to S22, S13 picking a conversation with S17 who is busy playing with his keypad; and S10 playing with his hair. Student 24 is attending to some assignment while S25 stares at him. Student 9 is seen busy squeezing pimples from his face (Figure 5.40a). The EC was rated at 2.8 during this interval, one of the lowest for the lesson.

*Figure 5.40.* Figure a, shows S9 squeezing pimples from his face. Figure b shows students involved in different activities with body resting on the table, minimal eye contact and lack of synchrony indicating lack of mutual focus and emotional energy.
This comment related to the video image captured in Figure 5.40 showing students got annoyed for losing time and for having to wait for madam to turn up to the class as expressed by Student 19 below:

In one of the classes madam did not turn up. We waited for her to show up but she did not. So we lost our time and I was really annoyed as the semester was coming to an end and we had many things to do such as assignment, projects, etc. If she had told that she will not be coming, we would have done something constructive. (Personal Interview)

Later the tutor expressed her apology during an interview session that she did not turn up for the class as she had misread the timetable. She said students must have felt irritated for having to wait for her.

5.4 CHAPTER SUMMARY

The type of activities students engaged in and the relationship structure present in the classroom forms the basis for the generation of EC in the classroom. The activities such as students’ use of artefacts like video clips, models, and engagement of students in a whole class interaction led to positively valenced EC. Activities associated with formal lectures and sessions led by unprepared presenters produced negatively valenced EC or low EC. There was another activity called group work that generated both positively valenced EC and negatively valenced EC at different times.

Positive EC was generated during the students’ use of video clips and models to assist their presentation. The EC in a particular interval peaked to as high as 4 and a few intervals also saw a drop in EC owing to the prolonged use of video clips. Group work activities generated conflicting EC as it produced both positively valenced EC and negatively valenced EC at different intervals across the lessons. For instance, some intervals have EC as high as 3.8 and some intervals have EC in negative (2.9). The mean EC for most intervals of activities associated with the lecture method and
presentations led by unprepared presenters fell below the average EC for all lessons (3.2), however few ECs were rated negative.

Seemingly, the mean EC for the relationship structure associated with humorous moments and the tutor supporting students’ work were positive for all the lessons. The EC of the class was positively valenced during humorous moments and when the tutor supported students in their class work. For instance, the average mean EC for lessons associated with humour was approximately 3.7 and that of lessons associated with the tutor supporting students’ work was recorded as 3.5.

Conversely, the EC dropped low due to violation of rituals by the tutor and students such as students interrupting classroom activities, the tutor discouraging students from participating in the classroom activities, the tutor not fulfilling students’ academic needs and the tutor not showing up to the class. For instance, the tutor not reporting to the class is a form of deviance on the part of the tutor to class norms causing a reaction from the students and negatively valencing the EC of the class. Absence of the tutor in the class led to students involving in disengaging activities and negatively valencing the EC. The tutor failing to fulfil academic needs of the students is also a violation of the professional rules thus producing an imbalance in the interaction and mood. As a result students assigned negative stereotypes against the tutor for failing to fulfil their academic demands.
Chapter 6: INTERVENTIONS TO TRANSFORM CLASSROOM EMOTIONAL CLIMATE

6.1 Introduction

As discussed in Chapter 4, cogenerative dialogue (cogen) was employed in conjunction with video data to support claims derived from the video analysis (i.e., the valence of emotional climate (EC) depended on the type of activity in which classroom participants engaged and the type of relationship structure present in the classroom). The purpose of cogen was to identify and evaluate in a joint effort what worked in the classroom and what did not with selected students. These conversations lead to some profound insights into the nature of the classroom as they discussed what they saw in the classroom, and the personal experiences of students of which the tutor was not aware, especially practices that disadvantaged students (Tobin & Roth, 2006). Cogens also proved to be important sources of data to stimulate reflection both for students and the tutor. Acting on student input, the tutor reproduced rituals that produced positive EC and the group collaboratively came up with intervention strategies (Roth & Tobin, 2002) to improve the practices that were considered to be detrimental to teaching and learning in the science class.

In a span of five months, seven cogens were conducted. The average time for each cogen was 40 minutes, ranging from 32 minutes to 45 minutes. All the cogens were held in the afternoon after class hours. The participants for the cogen included Pelmo (the tutor) and three students with Sonam (researcher) chairing the cogen session. Different students were involved during the cogens, so that a total of 17 students participated. In each of the first five cogens, the students were selected in such a way that both genders were represented. For instance, the participants for the
first five cogens, included two male students and a female student along with the
tutor and researcher. Female participants were not available in the last two cogens.
Four students appeared in the cogen more than once, and these students guided the
new members. Four intervention strategies arising from the cogen were implemented
namely the teacher’s use of encouragement, students’ leading a session, use of video
clips by students in their presentations, and use of humour. Analyses of data from
cogens and classroom interactions that are presented in this chapter address the
second research question: *How do pre-service teachers respond to interventions to
improve the emotional climate of a science class?*

The analyses are presented in terms of four assertions:

Assertion 1: The teacher’s use of encouragement improved students’ participation in
the lesson and the time spent on group activities.

Assertion 2: Students’ participation in the lesson and the time spent on group
activities improved during student-led lessons (presentations).

Assertion 3: Students’ participation in the lesson and the time spent on group
activities improved during lessons that involved students presenting video clips.

Assertion 4: Students’ participation increased in lessons involving humour.

Sections 6.2–6.5 address Assertions 1–4 respectively. The change in EC during
intervals where interventions took place is discussed in Section 6.6. Finally, the
chapter concludes with a summary in Section 6.7.

**6.2 Assertion 1: The tutor’s use of encouragement improved students’ participation in the lesson and the time spent on group activities.**

The first cogen was held in the afternoon of 11th March 2012. Two male
students and a female student were involved along with the tutor and researcher. As
briefed, the students shared what they liked and what they did not like about the previous lesson (lesson 2), that addressed the *Grade 10 Physics Syllabus*.

The classroom practices that disrupted classroom interactions included students giving *choral responses*, *limited student participation* in the classroom activities, and *prolonged group activity discussion*. The details of how these classroom practices affected the flow of classroom interactions in lesson 2 and how it improved in the subsequent lessons as a result of intervention strategies identified during cogens are discussed in turn.

*Choral responses* refer to more than one student responding to a question or sharing views simultaneously. Video analysis shows a very high frequency of choral responses recorded (60 times) in lesson 2. On three occasions (i.e., intervals 2, 8, and 15) during this lesson, the tutor became irritated or angry when students gave choral responses. In particular, she became irritated in lesson 2 interval 1 when two students responded to her question in chorus as detailed in Extract 6.1.


<table>
<thead>
<tr>
<th>Turn</th>
<th>Speaker</th>
<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Tutor</td>
<td>What are you supposed to do? group ah... (3s). What you are supposed to do?</td>
</tr>
<tr>
<td>02</td>
<td>S19 &amp; S28</td>
<td>We are supposed to ((choral response))</td>
</tr>
<tr>
<td>03</td>
<td>Tutor</td>
<td>#One at a time# ((staring at students who gave choral answer with pointed fingers directed at them))</td>
</tr>
</tbody>
</table>

In lesson 2, the session commenced with the tutor asking students to familiarise themselves with the content and assessment patterns of grade 9 Physics syllabus in groups. To ensure that the students are well aware of their group task the tutor asked students “what are you supposed to do?” in turn 01. Finding no volunteers the tutor reiterated the question. Students 19 and 28 responded in chorus in turn 02 which generated anger in the tutor (turn 03) as evident from Figure 6.1. The analysis of her
facial expression when she uttered “one at a time” shows the tutor giving a hard stare, with brows drawn together, and nostrils dilated (Figure 6.1). In the context of the classroom interactions described here, the facial expressions are indicative of the presence of anger (Ekman & Friesen, 1975). The figure also shows the tutor with index fingers of both hands pointing at students which is an indication of a warning in the Bhutanese context when students are up to some mischief.

Furthermore, the prosody analysis of speech “one at a time” in turn 3 shows an increase in pitch, energy intensity in the air, and speech rate consistent with the emotion of anger, when compared with similar neutral utterance “one at a time” from the same lesson. For instance, the pitch of an utterance “one at a time” ($F_0=269$Hz) is higher than the pitch for the neutral utterance ($F_0=229$Hz). Similarly, the energy intensity (75dB) and speech rate (5.9 syllables/s) is higher than the energy intensity (64dB) and speech rate (4.9 syllables/s), respectively for the neutral utterance.

Moreover, Student 7 and Student 13 also expressed in the cogen that the tutor should discourage students from giving choral responses (Cogen 1). This comment was seconded by Student 1, who stated that, giving choral responses is not healthy for the class as it gets unruly and chaotic when everybody speaks at the same time (Personal Interview).
Another undesirable aspect of lessons as perceived by the cogen participants were the limited amount of student participation during learning experiences. *Limited student participation* refers to the few numbers of students engaging in discussions or classroom activities. It was evident from the video analysis that only a couple of students participated in the classroom activities in lesson 2. For instance, in a class of 60 minute duration, only 14% (4) of 28 students contributed to the discussion including one female student. This also concerned the tutor during cogen 1 when she expressed that “more students should participate in the discussions.” She further cautioned that “students should ask more questions.” They should be more reflective in their thoughts and ask more analytical questions. They also should feel free to ask questions and interact more [frequently]” (Cogen 2).

Student 7 also pointed out that “specifically female students should open up” (Cogen 1). Sangay, another student echoed the concern raised by Student 7 on the need for female students to participate in the classroom activities when he expressed:

As far as my experience studying with girls is concerned, they seldom participate in the discussion or raise doubts or seek clarifications. They are shy and lack confidence. I mean girls rely on the bookish knowledge and don’t think beyond like boys. They lack critical and reflective skills.

Madam is doing a lot to encourage girls in the class. Madam gives more opportunities to girls to participate but due to complexities they shy away. For example, during group activity when madam provides opportunities to girls they pass it to the boys. Girls consider boys to be superior and intelligent. (Sangay, Personal Interview)

The *prolonged group activity* pertains to time spent by the students in pairs or small groups to attend to a particular task in the class that extended beyond the stipulated time given by the tutor. As evident from the video analysis that 60% (37 minutes) of the lesson (lesson 2) time was spent on students’ group activity
discussion. The prolonged discussion led to frustration of some students as they were left with less time to ask questions or clarify doubts as expressed by Student 3:

For me especially, I feel when we do discussion in the class we run short of time as a few talkative students hijacked most of the discussion time. Most of the doubts and questions remain unsolved. Today, I had a doubt but because of time constraints I did not get chance to ask. I get frustrated when I don’t get chance to clear my doubts. (Personal Interview)

These inferences were echoed by Student 18, who expressed, “our tutor does not manage time properly as a result sometimes we spend entire class time discussing just one question and as a result we are left with less time to discuss other questions” (Personal Interview).

Furthermore, in cogen 1, Student 7 expressed that prolonged group activity discussion affected them as “we have to wait for the rest of the groups to finish their task. We are left with nothing to do other than gossip or go to sleep”. The same apprehension was also raised by Student 1 who said “I also finished my task early and had to wait for my friends to finish. That made me drowsy and sleepy” (Cogen 1).

In summary, the data analysed in relation to lesson 2 and cogen 1 revealed that most students preferred to refrain from participating in class discussions, a high frequency of choral responses were recorded, and the group activity discussion was prolonged. These factors in concert possibly account for the low average EC for lesson 2 (i.e., 3.3).

The cogen was used as a platform to co-create interventions for the teacher to try in the next lesson that would attempt to transform classroom practices. The first cogen, for example, generated the first intervention strategy where the tutor would try to offer students greater encouragement to participate in class discussions. The
tutor agreed that she would encourage more students to participate in the classroom activities through support and reinforcement for/of both verbal and non-verbal contributions, as well as by creating a favourable classroom atmosphere for them to share their views openly. It was also agreed that the tutor would dissuade students from answering in chorus any questions with low cognitive demand.

Beginning with the next available lesson (i.e., lesson 4), the tutor encouraged students to participate in the classroom activities by providing opportunities to ask questions, express views without fear of ridicule, reinforcing their responses through verbal and non-verbal cues, and by being more receptive to their responses. For instance, Figure 6.2 shows the tutor encouraging Student 23 to speak. The tutor’s body is aligned towards the students and she is reinforcing the student’s response by nodding her head and using the emotive expression good as detailed in Extract 6.2.

![Figure 6.2.Evidence of mutual focus as the tutor encourages Student 23 to speak.](image)

Extract 6.2. Tutor encouraging students to participate in the class.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Tutor</td>
<td>What is the main purpose of this article? (3s) ((Pointing to Student 23))</td>
</tr>
<tr>
<td>02</td>
<td>Student 23</td>
<td>To assess students while working as a team to... ((nodding her head in acceptance and smiling))</td>
</tr>
<tr>
<td>03</td>
<td>Tutor</td>
<td>and to find out the advantage of this particular assessment practice.</td>
</tr>
<tr>
<td>04</td>
<td>Student 23</td>
<td>Yeah! ...assessment. Good ((smiling))</td>
</tr>
</tbody>
</table>
The pause of 3 seconds in turn 1 afforded the opportunity for the tutor to select a student (i.e., S23) who had a quiet and shy demeanour to answer the question previously posed. This is evident from the tutor’s hand gesture, eye gaze, body leaning forward and smiling (Figure 6.2). Student 23’s response in turn 02 was acknowledged by the tutor in turn 03 with a nod of her head and a smile. This non-verbal reinforcement by the tutor encouraged Student 23 to expand on her initial response in turn 04. The tutor further reinforced her response by saying good while smiling (Turn 05). Similarly, the tutor also supported other students by patiently listening to and acknowledging their responses with head nods and verbal reinforcement, suggesting mutual focus and shared emotion between her and her students as shown in Figure 6.3a and Figure 6.3b.

![Figure 6.3](image.png)

**Figure 6.3.** The tutor smiles as she maintains eye contact with Student 13 (a) and the tutor with shared mutual focus as she listens to Student 27 (b).

The tutor also dissuaded the students from giving choral responses. For instance, the tutor advised students to raise their hands if they wanted to share their views or solicit an answer to a question. Figure 6.4 shows students raising hands to draw the teacher’s attention rather than calling out randomly. For instance, Students (S13, S3, and S14) show hands to confirm queries from the tutor in Figure 6.4a and Student 8 was seeking the teacher’s attention to share his views as evident from Figure 6.4b.
Figure 6.4. (a) Students (S13, S3, and S14) confirming tutor’s queries through show of hands and (b) Student 8 raises his hand to draw the tutor’s attention.

The time spent on student group activities also improved by 50%. For instance, students took 37 minutes to complete a particular group task in lesson 2 but they took only 19 minutes to attend to another task in lesson 4 since cogen 1, though the group task in lesson 2 was more familiar (familiarising themselves with grade 9 Physics syllabus) to them than the task of reading an article (team testing) which was new to them in lesson 4.

The post-intervention data showed improvement in students’ participation, reduction in the frequency of choral responses, and a reduction in the time spent on the group activity. For instance, the number of participants increased to 32% in lesson 4, (post-intervention) from 14% in lesson 2. The number of choral responses too decreased substantially from 60 in lesson 2 to 38 in lesson 4 (Figure 6.5).
Figure 6.5 presents classroom indicators before and after the tutor’s use of encouragement as an intervention strategy. For ease of identification, the average EC and other parameters are represented by the letters a–d (Figure 6.5). More specifically, a – indicates choral response, b – refers to group activity time management, c – relates to number of students participating in the classroom activities, and d – the average emotional climate (EC).

These claims drawn from an inspection of the quantitative data represented in Figure 6.5 were also supported by students during subsequent cogens. That is, the tutor noticed the cogen participants were supportive and encouraged other students’ participation in the class. As the tutor recalled:

What I liked in lesson 4 was everybody was participating in the discussion. Last time they were so quiet. They will not open up unless coerced. But today they have opened up but girls still need to open up. I encouraged more girls to speak up. (Cogen 2)

Analysis of the video recordings also showed that the female participation rates increased as the lesson progressed. In lesson 2, only one female out of 10
participated whereas in lessons 4 and 5 the number of females who participated increased to three and five, respectively.

One of the students (i.e., S12) attributed her participation in lesson 5 to her tutor’s encouragement, as declared:

We felt encouraged to participate in the class (lesson 5) when we were told that following the discussion of cogen 2, girls were required to speak out more in the class. Therefore, we discussed in our groups that from now on we should participate more in the class. (Cogen 3)

This comment was supported by the tutor, who said:

Girls were more prepared this time as following cogen 2 they were encouraged to partake in the class discussion. So they must have prepared in advance putting together all their energy. It has become compulsory for them to ask question as if they don’t ask then, I will ask them to ask questions (he…he…he…). (Cogen 3)

These supportive practices were recognised by Student 10 in cogen 4 who said:

I was very happy yesterday (lesson 8) because most of the students got the opportunity to think and raise their voice in the class. That was a positive experience for us.

What I like about madam is she does not criticise or look down on us if our answer is wrong; instead she reinforced us and encouraged us to come up with more answers. I think she feels happy when we participate irrespective of any answer we give and she does not get annoyed. (Cogen 4)

Despite these positive shifts the average EC remained roughly the same in lessons 4 and 5 subsequent to the intervention, suggesting that this intervention did not have a significant impact on EC (Figure 6.5).
6.3 Assertion 2: Students’ participation and group activity time improved during student-led lessons (presentations).

The second cogen was held on 16th March 2012, six days after the first cogen. The participants comprised three students including one female student along with the tutor and researcher. As usual, the participants shared their perspectives on the lesson that immediately preceded the cogen, (i.e., lesson 4). In this lesson, the students were introduced to an article titled *Team testing*. The article was about an initiative taken by science coordinators for schools in Schaumburg, Illinois, USA to provide hands-on and process-oriented science education to middle level students by replacing a traditional mode of assessment. It was believed that the traditional mode of science assessment tests only facts and knowledge but the proposed mode of assessment of teamwork testing (group assessment) helps students to apply scientific methods in actual problem solving situations.

This mode of assessment requires students to work in groups to develop hypotheses, design experiments, gather data, and report results to their peers. Each stage of the model is marked by the tutor and the marks contribute to students’ final grades. This role of the teacher as a guide, and students engaged in science inquiry has become a great way to teach science and perhaps is even a better method of assessing science. Pelmo (tutor) was trying to replicate this mode of student assessment in the college setting with the aim that these teachers might reproduce it in Bhutanese schools later.

The highlights of the cogen included students’ expression of dissatisfaction with the lesson as they failed to comprehend the article. This was their first experience with an article written in a different context. For instance, Student 7 said:
In yesterday’s class we had to read and discuss an article [group activity] which was quite new to us. On top of that the summer heat [lack of air conditioner] made us more lethargic and put us to sleep. Owing to all this the class was bit boring. (Cogen 2)

In addition to summer heat (lack of air conditioner) that made students more lethargic and not able to focus on the assigned task, Student 27 expressed that since only one article was provided to a group of four members, students took more time to read and comprehend the article as detailed below:

Yesterday’s class was bit boring as we were made to read and discuss an article titled team testing. One article was provided to each group. In each group one member was supposed to read to rest of the members. I could not concentrate as others groups were reading as well. It could have been better if madam had provided an article each to each group so that we can read ourselves. (Cogen 2)

The tutor too realised that the students failed to comprehend the article and thus took a longer time to read it, as expressed below:

Initially, I instructed them to read the article for 5 minutes. When I went around I felt bored as students took a long time to finish reading the article. Some were half way through the article and some still on the first page. After making 2–3 rounds I pulled a chair and sat. Internally, I was feeling irritated and bored. Many thoughts were going through my head, such as, if I stop them from reading we cannot have a good discussion because people have not finished reading. If I let them read, the class time was drawing to a close. (Cogen 2)

The video image in Figure 6.6 shows the tutor after assigning the group activity (i.e., to read the article “team testing”). Even after six minutes, students neither completed the task nor asked any questions of the tutor which bored the tutor. Figure 6.6 shows the tutor staring blankly away from the groups at work with her left cheek supported by her left hand suggesting boredom.
In the 20th minute, the class saw a transition in the emotional expression of the tutor from negative to positive when she burst into laughter as a member from one of the groups sought clarification on whether “Schaumburg” in the article is a name of a person. Bhutanese students are not used to Western names and towns, so the question amused the tutor as illustrated in Figure 6.7 with her cheeks raised, corners of lips drawn back, mouth partially parted, and wrinkles below her lower eye lids.

During cogen 2, in pursuit of encouraging more students to participate in the classroom activities and make them responsible for their learning too, the tutor declared that she would adopt a new approach to encourage more participation. The
second intervention strategy was for students to lead the session with support from
the tutor, and is hereafter referred as a student-led class. In the context of this study,
a student-led class refers to a lesson initiated by students on the selected topic with
support from the tutor. This strategy is a form of coteaching.

Coteaching is now a well-established approach to distributing power and
responsibility for teaching and learning between participating coteachers. Coteachers
can involve more than one qualified teacher, or even students teaching with the
teachers. In the past decade, coteaching was developed as a form of teaching,
bringing professional development into a beginning teacher’s classroom for the
purpose of improving practice (Roth, Tobin, Zimmermann, Bryant, & Davis, 2002).
Coteaching is based on the fundamental idea that practices can be understood only
from the perspective of the multiple participating subjects. The collective effort of
teachers and researchers afford resources to students in their efforts to learn (Roth,
Lawless, & Tobin, 2000). It also enables beginning teachers to learn by working in
an activity at the elbows of mentors or researchers (Roth & Tobin, 2002).

Coteaching provides an opportunity for teachers to share and learn from each
other and to develop highly compatible forms of actions (e.g., Roth, 1998). Cogen
provides a forum for teachers and students to engage in an even-handed conversation
where differences in worldviews are allowed to emerge and generate new
possibilities for future actions and thereby engage in open learning. Thus, coteaching
and cogen serve numerous purposes such as providing a context for teaching in a
collective manner, and for the induction of beginning teachers, besides supporting
new and practicing teachers (Roth et al., 2000).

Coteaching and cogen form a dialectic pair as cogen is different from
coteaching yet they fuel each other (Roth & Tobin, 2002). There will be differences
in understandings and the potential for contradictions when teachers and students meet in cogen. These different views and contradictions about a particular lesson are viewed as resources for future coteaching rather than treating them as negative or trying to negotiate differences.

The first presenters to lead a session were Sither and Sangda on the topic *Measurement and Experimentation* in lesson 5. The lesson began with a brief introduction of the topic and the projection of a PowerPoint slide of a concept map of the topic on the screen. The students were asked to read a topic *Measurement and Experimentation* for ten minutes followed by discussions facilitated by the tutor and presenters.

All three students (S3, S12, and S18) who attended the cogen expressed that the lesson on *Measurement and Experimentation* was very interactive. Student 18, one of the two presenters, asserted that “what I like most was when I did the presentation because I had to read relevant texts and come prepared. The concepts which are not clear to me before were clarified by the tutor and through discussions” (Cogen 3).

The student-led classes were well received by students as evident from Figure 6.8, which shows Student 9, one of the presenters initiating the session and responding to a question posed by one of the students in lesson 5, while Student 2 responds with smiles and the body position of Students 5 and 13 are turned towards him.
Students’ participation in the classroom activities increased substantially following cogen 2. For instance, the number of students participating in the class increased by more than 100% since cogen 1 and a further 11% after cogen 2 (Figure 6.9). The female student participation rates also increased from 1 in lesson 2 to 3 and 5 in lessons 4 and 5, respectively. Some students participated more than 7 times in one class (lesson 5) and some even volunteered to come up to the front of the class to demonstrate or explain certain concepts by using the chalkboard.

![Figure 6.8. Evidence of mutual focus and emotional energy in a student-led class.](image)

![Figure 6.9. Classroom indicators for student-led class.](image)
The choral response reduced substantially from 38 in lesson 4 to 6 and 2 in lessons 5 and 8, respectively. Furthermore, the reduction in time required by students in their group work indicates greater efficiency in successful task completion of similar tasks. For instance, the time students were required to engage in group work improved from 19 minutes in lesson 4, 16 minutes in lesson 5 and three minutes in lesson 8 (Figure 6.9).

As evident from Figure 6.10, a, b, and c, more female students asked questions of the presenters than the pre-intervention lesson and initiated discussion while other students both males and females responded with attentive expressions (Figure 6.10a), demonstrated by bodies positioned to face the presenter (Figure 6.10b) and laughter (Figure 6.10c). Such alignment in gaze, body gestures and collective laughter reinforces the assertion that student-led classes improved students’ participation.

Despite the improvement in students’ classroom participation, use of group activity time, and reduction in choral responses, the average EC for the post intervention lessons remained roughly the same following the intervention, implying that this intervention did not have a large impact on EC (Figure 6.9).
The positive experiences of students in the post-intervention classes (e.g., lessons 5 and 8) were also echoed during cogens. For instance, Student 3 and Student 12 approved (Cogen 3) that the student-led class was good for a change and moreover, they felt free to interact with friends. For Student 18, leading a session was a good experience for him as it gave him firsthand experience of teaching and it also boosted his confidence to face a class of students (Cogen 3).

These comments were reinforced by Student 10, who said, “In yesterday’s (lesson 8) class there was an active involvement of students. The students got chance to raise questions and therefore effective learning took place compared to a class dominated by the tutor” (Cogen 4).

6.4 Assertion 3: Students’ participation improved during lessons that involved students presenting video clips.

The fifth cogen was held in the afternoon of 12th April 2012. The participants consisted of two male students and a female student with the tutor and researcher. As usual, the students shared their positive and negative experiences with the lessons. This time they had more positive things to share, which indicated the success of cogens as a tool to improve pedagogical practice.

The identified shortcomings of the lesson included the shallow content as both the tutor and presenters failed to explain the applications of a topic being studied in our daily life (Student 10, Cogen 4). As an intervention, the tutor declared that incorporation of video clips as a third intervention strategy will take care of the application part. For instance, she said in a class with another B.Ed cohort, a concept related to Force was explained with the help of a video animation. So therefore, we should include relevant video clips to the lesson to make a concept clearer.
Accordingly, the cogen participants agreed to trial the use of short video clip in subsequent lessons.

The first video clip was introduced in lesson 12, *Newton’s Laws of Motion*. As soon as the video clip on Newton’s Laws of Motion was screened, students fixed their gaze on the screen with their bodies leaning forward (Figure 6.11a). Similarly, viewing a video clip in lesson 13 with cartoon animation was clear evidence of the class’ mutual focus and interest in watching the video clip as illustrated by the spontaneous smiles (see Figure 6.11b), laughter, and head nods.

![Figure 6.11](image.png)
*Figure 6.11. Evidence of mutual focus and positive emotional energy. (a) The bodies of students leaned toward the screen showing animation of apple falling on Newton’s head. (b) Students with gaze fixed on the screen and smiling.*

Students also shared their positive emotions experienced with video clips during cogens and interviews. For instance, Student 3 claimed that his positive moment was during a presentation by Samten (Student 10) on *Newton’s Laws of Motion*:

Samten’s presentation contains simple and funny video animations on how Newton derived the three laws of motion. The most interesting part was when the clip showed an apple falling on Newton’s head, that moment was very positive for me. When we saw video clip on how laws worked the concept became clearer compared with the lecture based class. (Personal Interview)
Of course, whether or not this actually happened to Newton is immaterial. The animated clip evoked laughter in the classroom.

Student 9 asserted that video clips make the class interesting and help them gain attention unlike other classes which puts them to sleep. He further expressed that the video clip on *Forces* which had a duck flying motivated him a lot (Cogen 7). Student 17 reinforced Student 9’s sense of the positive impact of showing video clips in class when he referred specifically to the helpfulness of the animated video clip in comprehending the concept of a *Wave*, as follows:

> I especially like the video clip on waves. Till now we have not seen how waves are formed practically. We have learnt and seen waves only in the textbook images during our school time. Our teachers those days never used video clips to supplement their teaching. But yesterday, the video clip showed how different types of waves are formed and that interested me the most. Watching video clips gives a new experience of learning. It gives us firsthand experience of learning with animation and sound. (Personal Interview)

In another incident (Cogen 7), Student 9 said that video clips helped him understand “why it is easier to pull a branch of a tree from the tip and not from the end?” Similarly, the tutor was also appreciative of how video animation on *Torque* helped to clarify doubts raised by the students. For instance, the tutor expressed that:

> Video clip on torque explained a doubt raised by one student and secondly it created awareness among students that the efficiency of a machine is determined through the value of torque, that is, more the torque more efficient is the machine. So, students should not limit their search to textbooks, they should go beyond textbook and explore as there are lots of resources on the net such as the video clip on torque, the only thing is we have to find time. (Cogen 7)

She further stressed that the knowledge of torque can also be applied in our daily lives while procuring appliances from the market.
Following the video intervention, more students started to participate in the classroom activities. There were even incidents of students volunteering to come up-front to demonstrate certain concepts as evident from Figure 6.12. In the context of teacher education classes in Bhutan, this is a remarkable transformation that accentuates student agency to produce new practices through cogen. Figure 6.12a shows Student 10 arguing that “string cannot push an object?” However, his effort was appreciated by his friends. For instance, Figure 6.12b shows Student 7 applauding Student 10 for his input while other students (S21 and S20) were seen laughing, evidence of positive emotional energy.

Another incident that drew most students into the discussion was in lesson 13 on the question “Which one is easier ‘push or pull’?” raised by Student 27. Figure 6.13 shows the tutor, Students 6 and 2 enacting ‘pulling action’ supporting the views expressed by Student 18 that pulling of an object is easier than pushing.
Figure 6.13. The teacher and students (S6 and S2) in synchronised action of pulling.

Figure 6.14 shows that after the introduction of video clips in lesson 12, the average EC remained more or less the same in post intervention lessons 13 and 15 suggesting EC ratings were not particularly sensitive to the interventions. However, the students’ participation increased since cogen 5 from 12 participants in lesson 9 to 14 participants in lesson 15. There was a drastic drop in choral responses from 23 in lesson 9 to less than 5 in the subsequent lessons.

Figure 6.14. Classroom indicators for students’ use of video clips.
6.5 Assertion 4: Sessions associated with humorous moments led to more participation from the students.

In cogen 5, the tutor suggested the fourth intervention strategy that students should start their presentation with a joke or an anecdote as she observed that the other B.Ed cohort responded well to a lesson supported by humour. Video analysis of the lessons and cogen proceedings also showed that the students reacted well to humorous moments. The fourth intervention strategy adopted by the class was the deliberate attempt to create humorous events in class.

*Humour* here refers to remarks that naturally occur in the teaching of a Physics Education II module that evoke smiles or laughter. A study on the effect of humour on English learning with 200 female students of United Arab Emirates University found that humour helped students gain attention during class time. It was also reported that it increased their level of concentration and helped them learn difficult concepts (Aboudan, 2009).

Laughter stems from interactions and helps ease power relations between the teacher and students and can foster intimacy and solidarity (Roth et al., 2011). For instance, the ethnographic case study of a grade 7 science class in Australia reveals that laughter helped improve rapport between the teacher and students, encouraging students to give outrageous responses such as associating the name of the teacher’s husband with the science of construction of a bridge, the activity assigned to the class. The authors concluded that laughter serves as an important learning forum by both emphasising and overturning the seriousness with which science is usually associated. So laughter should not be separated from “scientific talk” and it helps to sustain a notion that science is fun (Roth et al., 2011).
In this study, students also responded positively when humour was created in class. For instance, Figure 6.15a shows students with a tired body posture in a lecture-driven class in lesson 2. In contrast, Figure 6.15b shows the presenter sharing a joke involving a master and his servant while the students (S15, S16, S7, S12, and S14) [Figure 6.16b] and the tutor (Figure 6.16a) respond with spontaneous laughter. As evidenced by mutual focus of attention (synchronous eye gaze, body leaned towards the presenter, and laughing) as well as students (S12 and S14, Figure 6.16b) and the tutor (Figure 6.16a) entrained to laughter generated by the humour indicates presence of shared emotion and positive emotional energy. This is supported by Roth’s (2009) study which reported that informal talk and jokes can mediate classroom learning and should not be considered as “off topic.”

*Figure 6.15.* (a) Students with a tired body posture in a teacher dominated class. Student 11 (presenter) sharing a joke (b).

*Figure 6.16.* (a) The tutor and students (b) responded with synchronous head nods, smiles, and eyes focussed.
This inference was consistent with the views shared by Student 16 about Sithup’s (S11) joke as expressed below:

It was during a lesson on “force” I was feeling quite drowsy and sleepy. Sithup started his presentation with a joke about an absent minded master and his servant. His joke was a good appetiser for the class as it helped draw everyone’s attention in the class. (Personal Interview)

For Student 7, humorous moments helped set mood for the class as expressed below:

The best or the highest point that made the class positive was the humour created by madam that sets the mood for the class. She has the quality to convert unhealthy conversation to mild jokes. For instance, the unexpected joke like the marker pen which was not writing is not a joke but she changed into joke. (Personal Interview)

The findings of Aboudan (2009) that humour helps students gain attention in the class is consistent with the views expressed by Yangchen in the cogen that, “When tutor keeps lecturing I feel sleepy. But whenever there is laughter in the class it keeps me awake. It also sets mood for the class and motivate us to concentrate on the lesson” (Cogen 2).

Humour also facilitates students’ participation in the classroom activities by creating positive classroom climate and reducing barriers between the tutor and students as expressed by Student 10 below:

In other classes I don’t feel free to ask or respond to questions for fear of ridicule from the tutor and other students for giving wrong answers. In madam’s class I don’t have any of these feelings because of her frankness, we have created relations with her, and so we don’t hesitate to interact with her in her class. (Cogen 5)

This inference was echoed by the tutor, who expressed that:
They have shown drastic improvement. Initially before you (researcher) joined my class, hardly anybody speaks. It is only me who comes to the class, talk all by myself and leave. There were only a couple of them who would respond to my queries. It was worst with girls as if a plaster was put on their mouth (ha…ha…). This year, I find that many of them have opened up but still few of the students need to open up. (Cogen 5)

Another incident that generated laughter was in lesson 12 when the tutor encouraged female students to ask a question before the closure of the lesson. When no female students came forward, to make the situation milder Sither and the tutor created humour by saying female students are “thinking inside and not thinking outside”. The details are provided in Extract 6.3.

Extract 6.3: Humour – Lesson 12

<table>
<thead>
<tr>
<th>Turn</th>
<th>Speaker</th>
<th>Dialogue</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Tutor</td>
<td>So girls, any questions. Last question ((smiling and maintaining eye contact with girls))</td>
</tr>
<tr>
<td>02</td>
<td>Student 9</td>
<td>Thinking inside</td>
</tr>
<tr>
<td>03</td>
<td>Tutor</td>
<td>(5s) Yes (laughing)). (4s) Yes, girls are thinking inside and not thinking outside (ha...ha...)</td>
</tr>
<tr>
<td>04</td>
<td>Student</td>
<td>((The whole class broke into laughter))</td>
</tr>
</tbody>
</table>

A few minutes before the closure of the lesson (lesson 12) the tutor encouraged female students to speak up if they have any questions as seen in turn 01. The tutor called on female students, maintained eye contact and smiled indicating the tutor’s concerns for female students. When no female students came forward Student 9 filled up the silence by saying females are thinking inside in turn 02. The tutor complemented his (S9) remark in turn 03 accompanied by hilarious laughter. The rest of the class responded with laughter suggesting the presence of emotional energy.

Another humorous moment was created when the tutor once again taunted the female students in a friendly manner as described in Extract 6.4 below.
Extract 6.4: Humour – Lesson 15

01 Serpo  Madam, today we want to leave early as we have football match.

02 Tutor  ((smiling)). It all depends on girls how they participate. If they ask many questions then I will let you go by 4 pm and if no questions from the ladies side then we have to wait till 4.30 pm.

03 Students  ((The whole class broke into laughter))

04 Student 4  Yes madam

05 Student 1  We will give opportunity to girls

06 Tutor  (3s) now start reading and think about questions [he...he...he...]

07 Serpo  [Girls...girls...] please start reading fast ((laughter in the class))

Serpo requested the tutor to end the class early as the male students are participating in the on-going inter class soccer match scheduled at 4.20 pm that day in turn 01.

The tutor was aiming to encourage female students to participate in class discussion, and to create a humorous feel to the conversation by declaring that it all depended on how well the female students participated in the class wearing a broad smile (02).

The whole class reacted with laughter in turn 03. To add more humour to the conversation, Student 1 said the male students will give opportunity to them in turn 05. The remark made by Serpo in turn 07 set the whole class into laughter suggesting the generation of positive emotional energy.

As reflected in Figure 6.17 in the post-intervention lessons, there was improvement in the students’ participation in the classroom activities. For instance, only 4 students participated in the classroom activities in lesson 2 and the number of students participating in the classroom activities increased to 12 each in lessons 9 and lesson 13, and 14 in lesson 15. There is seemingly a greater improvement in the way students conducted themselves by not giving choral responses in the subsequent lessons but the improvement in class EC was not significant though the figure shows a slight rise in EC with the introduction of humour as an intervention strategy.
Because laughter can prove useful as a resource for learning and understanding science, it should not be considered a nuisance or be seen as eating away at the class time (Roth et al., 2011).

Figure 6.17. Classroom indicators for humour.

In my study, the average EC for the lesson in which the intervention occurred was an overall indicator for each lesson. That is, it consisted of the average EC for all intervals recorded within any one lesson. This average measure was not sensitive to the ebb and flow of EC within each lesson. Though the introduction of intervention strategies improved classroom EC indicators such as; students’ participation in the classroom activities, efficient use of group activity time, and reduction in the choral responses but it did not bring a significant impact on the class EC. Therefore, it is only possible to examine the impact of the intervention through a microanalysis of the EC related to the interventions closest to the individual three-minute intervals during a lesson when the EC was recorded. This is undertaken next in Section 6.6.
6.6 Change in emotional climate during intervals where intervention took place

As discussed above, though the intervention strategies appeared to improve the EC of the intervals where interventions occurred, the average EC for the lessons in which the interventions took place is not sufficiently sensitive to show significant improvements across the class means. This is perhaps due to the fact that students’ emotional experiences tend to be momentary which means the EC is likely to be positive during only those intervals where the intervention took place rather than the overall lesson.

The following section discussed the impact of the interventions through a microanalysis of EC of the intervals where interventions actually took place. *The tutor’s use of encouragement* was the first intervention introduced to bring improvement in students’ classroom practices such as students’ participation in the classroom activities, reduction in choral responses, and efficient use of group activity time. The tutor used encouragement strategy in four lessons. Figure 6.18 presents the average EC for lessons (i.e., L4, L5, L8, and L15) against the average EC of 3.3 represented by a horizontal dotted line for the pre-intervention lesson 2. The Figures also show intervals from different lessons where the intervention took place. For instance, in lesson 4, intervention took place in intervals 2 and 8, in lesson 5 (intervals 6 and 13), in lesson 8 (intervals 8 and 9), and interval 11 of lesson 15.
The average EC for the pre-intervention class is shown as a horizontal dotted line for ease of comparison. The acronym AEC is used to represent average EC for the lessons that include the intervention. The intervals were represented by the letter “I” with a number subscript (e.g., I₂) for easy identification (Figure 6.18). Figure 6.18 shows that the tutor’s use of encouragement did not bring significant improvement in the class EC averages of post-intervention lessons. The class EC (3.3) remained flat in lessons 4 and 5 (compared to EC of 3.3 for lesson 2), however there was a slight rise in average EC in lesson 8 (3.4) and lesson 15 (3.5). Nevertheless, the rise in EC during intervals where the intervention took place was consistent when compared against the ECs of pre-intervention lesson 2 and preceding lessons. For instance, EC spiked in interval 8 (3.4) of lesson 4, intervals 6 (3.4) and 13 (3.4) of lesson 5, intervals 8 (3.6), 9 (3.5) and interval 11(3.6) of lessons 8 and 15, respectively.

The second intervention was student-led presentations (coteaching). The student-led presentations occurred in lessons (L₅, L₈, L₉, L₁₃, and L₁₅). The intervals where student-led presentations took place along with the EC were also

![Figure 6.18. Change in EC during intervals where the tutor used encouragement as an intervention.](image-url)
reflected in Figure 6.19. The average EC ratings of post-intervention lessons indicate that the rise in average EC of the lessons was not very significant however; the rise in EC during intervals where intervention student-led class took place was sensitive to changes, as detailed in Figure 6.19. The Figure reveals that students felt very positive during intervals where students-led the session as evident from the sharp rise in the ECs. For instance, the rise in EC ranged from 3.5–3.7 across intervals of lessons 5, 8, 9, 13, and 15 when compared to pre-intervention class EC average of (3.3). The highest EC of 3.7 was recorded at intervals 6 and 4 of lessons 9 and 13, respectively.

![Change in EC during student-led class](image)

*Figure 6.19. Change in EC during intervals where the students led the sessions.*

The third intervention was the use of *video clips to assist student presentations*. The class average EC for the three post-intervention lessons (L12, L13, and L15) which had video clips did not show any improvement in EC. For instance, the average EC for lesson 12 and lesson 15 remained at par with that of the pre-intervention lesson EC (3.5) and the EC slightly decreased to 3.4 in lesson 13. However, the increase in EC was sufficiently sensitive during intervals of the
subsequent lessons where video clips were used as a strategy to assist lessons following cogen 4 (lesson 9) as detailed below. The average EC (3.5) of the pre-intervention lesson 9 and that of subsequent lessons where intervention took place was way below the intervals of the post-intervention lessons which showed a sharp rise in EC. For instance, as evident from Figure 6.20 the EC increased to 3.7 in interval 2 of lesson 12, 3.9 in interval 1 of lesson 13 and 4 and 3.8 in intervals 2 and 13 of lesson 15.

![Change in EC during video assisted lessons](image)

*Figure 6.20. Change in EC during intervals where video clips were used as an intervention.*

Similarly, despite these positive shifts in the intervals where humour was used as an intervention the average EC remained roughly the same in the overall lessons, suggesting that this intervention did not have a significant impact on the average EC of the lesson. Figure 6.21 shows three lessons (L12, L13 and L15) where humour was used as an intervention and their average EC (3.5) though positive remained close to the average EC of the pre-intervention lesson 9 (3.5). Nonetheless, the ECs of the intervals where intervention occurred spiked. For instance, the EC in interval 11 rose to 3.6 in lesson 12 and 3.9 in interval 1 of lesson 13. Likewise, the EC improved to 3.6 in intervals 11 and 12 of lesson 15 as shown in Figure 6.21.
In conclusion, it is confirmed that emotions are momentary and may not saturate or resonate to the remaining part of the lesson. This was revealed in Figure 6.21 with flat class EC averages and spiked ECs during intervals where the interventions occurred.

6.7 CHAPTER SUMMARY

Cogen was employed as an intervention and as a research method for supporting claims obtained from video data. In a study period of five months, seven rounds of cogens were conducted. The cogens were structured so that all student participants and their tutor could speak openly with the aim of assuming collective responsibility to improve the quality of teaching and learning in the classroom. During these discussions both the tutor and students became aware of their beliefs and feelings about their conduct, teaching and the classroom. These discussions helped mitigate the power differences between students and the tutor, and to help find solutions regarding what was to happen in subsequent lessons.
Following cogen, the participants identified four intervention strategies to improve classroom EC and make learning of science enjoyable and a positive experience for the students. The introduction of four intervention strategies; namely, the tutor’s use of encouragement, a shift in pedagogy from the teacher dominated class to a student-led class, the use of video clips to aid student presentations and use of humour in the classrooms were well received by the students. These strategies helped to generate positive emotional energy in class and recall memorable positive events following the class and evident during interviews. Yet, they did not appear to improve the average EC ratings for each class despite having an observable impact on classroom practices and student responses. This suggests that despite particular students contributing to classroom discussion more frequently and a reduction in choral responses to the tutor’s questions; that students’ ratings of EC was not sufficiently sensitive to the interventions even though the classroom climate was more positive than earlier lessons when the tutor led by predominantly lecture mode lessons.

However, the EC was more positive during those intervals where the interventions occurred. For instance, the classroom EC spiked during those intervals where the tutor encouraged students to speak out or created a forum for students to participate in the classroom activities through reinforcement both verbally and non-verbally.

The rise is EC was also very noticeable through all the intervals during student-led classes, video assisted lessons, and when humorous instants were observed. The EC peaked at 3.9 in interval 1 of lesson 13 and 4.0 in interval 2 lesson 15 when the lessons were assisted with video clips. The use of humour also led to spikes in EC readings at 3.9, interval 1 of lesson 13. The insensitivity of average ECs and the
positive ECs during those intervals where the intervention occurred confirms the
notion that emotions are momentary and emotional experiences tend to be more
fleeting.

The success of this study, specifically cogen, is also revealed through the post
reflective exercise carried out by the students. The students were asked to write their
impressions about their experiences with the Physics Education I module offered
prior to the research and during the study of Physics Education II. Most of the
students expressed that they joined the teaching profession since they did not qualify
for medicine, engineering or higher degrees due to receiving a low merit. Besides,
they also cited that the earlier sessions with Physics Education I were not very
impressive and the content was very shallow. Their lack of interest in teaching
amalgamated with low confidence and apprehension in participating in the classroom
activities added to their already laden woes.

Their experiences with this study and cogen have transformed their mentality
towards the teaching profession. Many cited that the post cogen sessions were very
interactive and enjoyable. Their subject knowledge became deeper through their
research and the use of video clips to assist learning was very enriching. They were
also exposed to new ideas like improvisation of scientific apparatus. Furthermore,
interactive sessions and having to conduct presentations in the class boosted their
confidence to face crowds.

The number of participants for cogen was three as recommended by Tobin &
Roth (2006). Since the purpose of cogen was to listen and learn from the participants,
it is important to have a small group to permit all participants to speak and be heard.
According to Tobin and Roth (2006) selecting participants so as to maintain diversity
of students represented in the cogen was an important criterion. In order to maintain
diversity of participants, samples include two male students and a female student along with the tutor and researcher.

Tobin and Roth (2006) argued that often the availability of research participants for cogen was a problem since cogen was usually scheduled as soon after the class as possible when some students have to attend to other classes. In my study, all cogens were scheduled towards the evening hours so that their engagements were not disrupted. Students were accessible at this time because most live on campus.

In conclusion cogens were successful for it helped the tutor and students to diagnose classroom activities that generated successful interactions and deal with those activities that were deleterious to the class by adopting intervention strategies. Cogens also provided a platform for the tutor and students to interact openly. In course of the interactions students feel free to create successful interactions and, consequently, there is a possibility for them to reproduce similar practices in their own classes in future.
Chapter 7: DISCUSSION

7.1 INTRODUCTION

A nation’s future is mirrored in the quality of her youth and that it is the government’s sacred duty to provide a good education and a conducive environment for young people to become strong, capable leaders for the future (His Majesty the King of Bhutan, National Day address, 17th December, 2007).

His Majesty’s concern for the education of Bhutan’s youth is articulated in one of the nine domains of the Gross National Happiness (GNH) policy which is to achieve quality of education in the schools and institutions in Bhutan (Zam, 2008). Yet, the fulfilment of GNH in the near future is unlikely because schools and colleges are grappling with teacher shortages (VanBalkom & Sherman, 2010); the existing teachers are overburdened with their teaching load and other administrative roles; and the classes are conducted in shift systems (Johnson et al., 2008). The poor working conditions and limited resources exacerbate the problems with morale of already de-motivated teachers (Dorji, 2007; Wangdi, 2008).

Science teaching is affected the most because shortages of qualified teachers in these disciplines are greatest. As a consequence of these shortages, humanities teachers are required to teach science, especially in lower grades (Johnson et al., 2008). Moreover, the grade 12 graduates enrolling in the pre-service science teaching programs have demonstrated lower academic achievement in the sciences than those who choose engineering and medicine and even have less aptitude for teaching (Johnson et al., 2008; VanBalkom & Sherman, 2010). Some of these teachers are emotionally vulnerable because they joined the teaching workforce since they failed
to qualify for other viable study programs such as medicine or engineering that they perceive to have brighter futures or with more attractive working conditions.

Other disincentives include the perceived academic rigour at college, the unattractive pay packages, remote placement, and limited scope of training opportunities once they become teachers, unlike civil servants. Academic rigour refers to crammed curriculum and severity of academic activities that they have to attend to while undergoing B.Ed programs at the college. Unlike other programs students attending to B.Ed programs have to attend to various modules such as Pedagogy, Child psychology, Counselling, Information Communication Technology, and Research skills besides core subject modules. Furthermore, they are required to carry out numerous class presentations and lead discussions to develop confidence and reflective skills. This repertoire of activities makes teaching jobs more demanding which keeps most students away from joining teaching.

Ura’s (2009) Gross National Happiness (GNH) survey on emotions of Bhutanese identified the prevalence of negative emotions in major districts (states) of Bhutan. The survey consisting of 14 emotional indicators both positive and negative was administered across 20 districts in Bhutan. The findings showed the presence of negative emotions across 12 districts with Thimphu, the capital city, leading the table. This implies that if the pattern of socialisation and nature of education in the schools and colleges of other districts are modelled on Thimphu, they too might follow soon after.

My study was conceived to initiate the process of realising an ideology of GNH by producing high quality science teachers who have experienced positive emotional activities during their training period in the university. As Zembylas (2002) noted:
If we want progress in science education, we need to look more carefully at the emotions of science teaching [and learning], both negative and positive emotions, and use this knowledge to improve the working environment of science teachers. (p. 98)

These science teachers in turn can produce home-grown scientists and leaders to steer the country forward.

Interaction Ritual Theory (IRT) and principles from the Sociology of Human Emotions were used in this study to interpret the interactions that occurred within the observed class. It is hoped that pre-service teachers who experience positive emotions at university can replicate the pedagogy that produced positive EC and avoid those pedagogies that produced negative EC or low EC in school classrooms. Cuseo (1997) also suggested that students’ emotions can be managed by employing engaging pedagogical approaches. For instance, use of cooperative learning promotes an atmosphere of teamwork, solidarity, student-faculty research, and acceptance.

Chapters 5 and 6 in this thesis presented evidence to support claims that answered the following two research questions:

1. What affects the emotional climate in a science classroom for pre-service teachers?

2. How do pre-service teachers respond to interventions to improve the emotional climate of a science class?

In this chapter, the main findings of the study are discussed in relation to these two questions. Question 1 is discussed in Section 7.2 and Question 2 is discussed in Section 7.3. Section 7.4 discusses how positive EC in science teacher education is generated and the production of negatively valenced EC or decrease in EC is outlined in Section 7.5. The discussions from these three sections culminate in Section 7.6
which includes a way forward for improving science teacher education and science teaching in schools by identifying the conditions that would enable better science learning outcomes for students in pre-service teacher education. This chapter concludes with a summary of the chapter in Section 7.7.

7.2 EMOTIONAL CLIMATE OF A SCIENCE CLASS

As elaborated in Chapter 5, the valence of EC in the classroom depends on the types of activities students engage in and the types of relationship structures present in the classroom. Pre-service teachers’ ratings of EC using clickers helped identify salient events/activities that generated positive and negative emotional arousal in the tutor and students.

With respect to the types of activities students are engaged in, the presentation of video clips and models by students were characterised by high EC ratings. The use of short video clips and models helped students relate theory to practice and make abstract science concepts clearer. The video animation and models also generated laughter and fun among students and the tutor, thus creating a positive learning environment.

The practice of students leading a session gave them firsthand experience of leading a class. It also provided a forum for other students to participate in the classroom discussion as they felt comfortable to interact during the sessions led by their peers. The interactive whole class discussions were characterised by students demonstrating a strong knowledge of the subject and provoking the tutor and presenters with questions. In contrast, the formal lectures and presentations by unprepared presenters were characterised by univocal interactions, lack of eye contact, lack of humour, and low levels of emotional energy. Shifts in EC occurred
during prolonged group activities. When the group activity commenced the class EC became positive but if these activities became drawn out the EC dropped.

Concerning relationship structures, the use of humour and the tutor supporting students’ work helped build a strong rapport between students and their tutor. Humorous moments mediated the relationship between the tutor and students. Students found the tutor amicable and approachable when they laughed together or created humour in the class. Humour also toned down the serious nature of the class as students freely shared their ideas.

7.3 STUDENTS’ RESPONSE TO INTERVENTIONS

As elaborated in Chapter 6, cogen not only diagnosed what worked and what did not work through open discussions between the tutor and selected students, but also provided a forum in which intervention strategies were generated to improve the classroom EC. The tutor built on the activities that produced positive EC and introduced interventions to improve the success of other activities that generated negatively valenced EC or low EC.

Numerous interventions that were recommended during cogens were tried in an effort to address the second research question: *How do pre-service teachers respond to interventions to improve the emotional climate of a science class?* The implementation of the intervention strategies such as teacher encouragement, use of artefacts like video clips to assist student presentations, use of humour, and students leading class sessions improved student participation in class activities and their conduct in the classroom. This positive shift in classroom interactions improved the EC of the intervals where interventions occurred, but the increase in average EC for each lesson was not very significant. Perhaps this can be explained by noting that emotional states are momentary. This means that the EC is likely to be positive
during only those intervals in which the intervention actually took place rather than
the lesson overall or even within the three-minute intervals during which EC ratings
were made. This has relevance to Bellocchi et al.’s (2013) study which found that the
average EC during formal class debate sessions was positive but specific events such
as informal talk and voting discussions that preceded and followed the debates
generated very high positive EC values. This implies that the average EC of the class
would have been neutral or negative in the absence of these very high positive EC
events. In my study too, the overall class EC was above average but the EC spiked to
more positive during specific events such as students leading a presentation,
interactive whole class discussions and use of artefacts such as video clips and
models. The implication of such a finding is that an entire lesson can be saturated
with positive EC when specific and short length events of high emotional intensity
are displayed (Bellocchi et al., 2013).

Cogen helped improve EC of the class because interventions were coproduced,
and these worked. By working together with her students through cogen, Pelmo (the
tutor) became aware of the structures of various positive activities (e.g., success of
humour, interactive discussion, use of video clips, group activity, and students
leading a session) and negative activities (e.g., formal lecture, the tutor failing to
meet academic needs of the students, denying opportunity for the students to
participate, and classroom interruptions). The classroom interactions became
successful only when the tutor and students collaborated during the positive activities
and when the class was not dominated by the tutor.

In summary, even though these interventions appeared to improve the EC of
the intervals where interventions occurred, the increase in average EC of the class for
the duration of a lesson was not significant. This and other implications are considered next.

7.4 GENERATING POSITIVE EMOTIONAL CLIMATE IN SCIENCE TEACHER EDUCATION

The key elements that contributed to positive classroom EC in my study were evident in the events that involved interactions between students and between students and the tutor. Successful interactions were characterised by two factors. First, they were characterised by activities where participants developed intense mutual focus of attention, shared emotions, and positive emotional energy (Collins, 2004). Secondly, they were characterised by the presence of relationship structures that helped members to develop shared understanding and maintain a common focus of attention.

7.4.1 Activity matters

Classroom activities employed by teacher educators are vital in the development of positive EC. The activities for which students indicated positive EC included the use of task-related artefacts, informal activities, and coteaching (presentation led by students). The positive EC arising from coteaching is not surprising, given the findings of some recent studies that have shown similar positive outcomes (Murphy & Scantlebury, 2010; Siry & Martin, 2010).

7.4.1.1 Task-Related artefacts

I observed that mutual focus of attention was achieved when presenters used task-related artefacts such as video clips, models, chalk board, PowerPoint slides, and documents. Though physical co-presence is needed for mutual focus of attention to occur (Collins, 2004), Metiu and Rothbard (2012) contend that an artefact which
can focus people’s attention, may be more important than physical proximity to accomplish mutual focus of attention. Mutual focus of attention occurs in classroom settings when there is an artefact that can attract and maintain people’s attention and effort.

Metiu and Rothbard’s (2012) findings confirm the results in my study which demonstrated that students’ understanding of a scientific concept under study was facilitated by the physical proximity of students using artefacts. For instance, when video clips or models were displayed, students were found entrained, and laughter ensued after a funny video animation or when presenters shared stories about models articulated by emotive body gestures and humour. Besides, students also worked in close physical proximity while engaged in group activities, sharing marker pens to write on the chart paper, reading documents together, and sharing a laptop to do presentations.

Another manifestation of mutual focus of attention and shared emotion was when student presenters were applauded by the audience for clarifying a concept with the help of video clips and other artefacts leading to positive emotional energy. The use of artefacts was critical in interactions that generated and maintained mutual focus of attention. For instance, the video animation and model presentations made science concepts explicit even if the presenters were brief with their presentation. This act of students applauding their peers for clarifying a scientific doubt or attempting to clarify certain concepts through demonstration and writing on the chalkboard coheres with the findings of Olitsky (2007) who found that high school students collectively applauded peers when they successfully solved chemical equations on the chalkboard.
7.4.1.2 Informal activities

In the context of this study, informal activity refers to any activity organised around students where there is an exchange of ideas and views openly. My study showed that students reported positive EC during informal activities such as group work, student presentations, and interactive whole class discussion. For instance, in my study there was a sharing of ideas and opinions yet at the same time respect for each other’s views during group activities, student presentations, and interactive sessions. As students worked together there was synchrony in their gazes, smiles, and body alignment so that they could hear the group’s conversation without disturbing other groups. As asserted by Collins (2004), the threat to interactions from outsiders will weaken mutual focus of attention. In this study, the teacher made sure that students did not make too much noise in discussions so that it did not interrupt other group members. There were incidents where group members were trying to shield the other groups from overhearing their discussion (e.g., brainstorming topics for the model design) lest the other groups replicate what they intended to do for the model project. During group activity, besides solitary contributions of individuals there were interactions between members as they pooled their knowledge and insights to solve the problem.

My finding that informal activities generated positive EC and formal activities produced negative or low EC reinforces the findings of Bellocchi et al. (2013). For instance, the tutor and students discussing the whereabouts of and sharing a lunch menu in my study is synonymous to the lecturer inquiring with students about how they spent their term break when the class was waiting for a debater to arrive in Bellocchi’s class. These activities opened the door for the lecturer and students to interact freely and share feelings of warmth and pleasant attitudes among students.
and with their lecturer (Bellocchi et al., 2013). Similarly, in my study interactive whole class discussions also engaged students actively through informal debates and discussions. These debates and discussions drew multiple views on a concept being discussed leading to heightened mutual focus of attention and shared emotion. Most students expressed during interviews that interactive whole class discussions were very interesting and educative as they could share their views openly and learn from each other.

7.4.1.3 Coteaching

Another activity that generated positive EC in the science class was during successful interactions carried out during presentations led by students (coteaching) as detailed in the following section.

From the perspective of an idealised coteaching model the collaborative partners should share equal load of planning, teaching, and managing behaviour of the students (Scruggs, Mastropieri, & McDuffie, 2007). But in the setting of this study, coteaching did not resemble this ideal; rather it was a shift in teaching mode from the teacher-dominated class to students leading a class with support from the tutor. As student(s) led the session the tutor played a role as an assistant by moving around the class helping students, addressing behaviour issues, and supporting the student-presenters when they went wrong or when they were challenged academically by other students.

The participants in Scruggs et al.’s (2007) study indicated that they experienced more social benefits than academic outcomes from collaborative teaching. In contrast, my study identified academic benefits from working with each other in teams, and with help from the tutor during class presentations. An example of the academic benefits reported by the students in this study includes (see section
5.2.1 - interview transcript S10 and S13; section 5.2.3 - Extract 5.3, interview transcript S21, tutor, and S9). Coteaching provided an opportunity for the tutor and student-presenters to learn from each other (Roth, 1998). The sessions also became interactive in cotaught classrooms as the presence of the tutor was a source of confidence for the presenters as the tutor could intervene whenever required to sustain the success of classroom interactions. This exercise provided an opportunity for students and the tutor to share and learn from each other. The students described this exercise of supporting students’ work as very enriching and effective for them. The tutor also felt there were genuine intellectual exchanges during these presentations.

Not only do the classroom activities employed by teacher educators matter, but also the relationship developed between students and their tutors are important in the development of positive EC, as detailed next.

7.4.2 Relationship structure

The relationship structures that produced positive EC of the class included humour and the tutor supporting students’ work as detailed next.

7.4.2.1 Humour

In my study, the classroom EC peaked whenever there was a humorous moment. Laughter or episodes where students responded in a humorous way during interactions created resources for the students and tutor to sustain their conversations. For instance, laughter helped produce a lively classroom climate that shaped how the students and their tutor were emotionally connected and engaged in learning together. These interactions broke the general notion that science is a serious business. It supported enhancement of science learning by producing positive emotions in the students and tutor alike. Humour also created a relaxed environment
that positioned students and the tutor as colleagues rather than a more traditional hierarchical relationship. Sharing of jokes encouraged students to interact with their tutor openly and to take part in classroom discussions.

These findings are supported by prior research which showed that humour can be beneficial to classroom learning (Fisher, 1997; Kher, Molstad, & Donahue, 1999), promotes confidence, creates a positive attitude toward the subject matter, and reduces anxiety (Powel, 1985). Evidence from past studies also suggests that the use of humour improves classroom climate, increases student-teacher rapport, and reduces tension (Provine, 2002; Roth et al., 2011). Similarly, the authors who studied classroom talk and laughter recently in one grade 7 Australian science classroom concluded that laughter mediates classroom proceedings and the learning that emerges, so it should not be dismissed as irrelevant (Roth et al., 2011).

My study also demonstrates that students reciprocated well in a class where they were afforded opportunities to participate actively in discussions where their views were not rejected or cajoled. For instance, the collective laughter and positive emotion was aroused when the tutor and students made fun with some students in the course of interactions leading to collective effervescence. Similarly in one of the sessions in my study when the tutor was about to close the session, a few students wanted to continue the session by extending the joke initiated by the tutor earlier. My above finding coheres with Tobin et al.’s (2013) study, which reported that the teacher giggled and used various emotive gestures to contain her laughter when a student presented his science project in a comical way. Her incessant laughter and body action appeared contagious drawing the student presenter and the rest of the class into synchronised laughter. Such collective effervescence generated through role play helped in the smooth transition from collective laughter to a serious
discussion of science. As with all learning, learning science also requires a non-threatening environment.

This confirms the assertion that non-threatening environments created by humorous moments reduces the institutional position of hierarchy between teachers and students inviting students to offer open responses. Such interactions are very different from the traditional teacher-student relationships in Bhutan.

7.4.2.2 The tutor supporting students in class work

In my study the classroom EC peaked whenever the tutor provided professional support to students. The kind of support rendered by the tutor included, the tutor responding to questions raised by the class when student presenters ran short of answers, the tutor helping presenters to calm down the class when they go out of control, the tutor supplementing student presenters’ explanations of certain concepts, and facilitating class discussions through prompts and redirections.

Both the tutor and students viewed this exercise of helping each other’s work as very enriching and effective for them as they learnt from each other. In that way there was mutual focus and team spirit between students and the tutor. Instances such as the tutor seeking views of other students and collegially solving doubtful issues together help build a team work between students and the tutor and encourage students to participate in the classroom activities without hesitation.

In my study whenever there were differences of opinions among students, the tutor tried to negotiate these differences by presenting her opinions. This finding coheres with Tobin et al.’s (2013) study of a beginning science teacher who sought to repair discussion rituals in order to produce and maintain positive EC by strengthening social bonds and networks. The teacher facilitated any clashes and
misunderstandings between individual students’ responses and views using verbal and non-verbal cues.

Students find teachers with sound social and emotional aptitude to be approachable and respectful (Jennings & Greenberg, 2009). It is important for teachers to sustain a positive EC by treating fairly and adopting teaching pedagogies that embrace diverse learning needs of all the students in the class (Newberry & Davis, 2008). A teacher with emotional aptitude who understands his/her own and their students’ feelings is in a position to mitigate negative emotional consequences (Jennings & Greenberg, 2009). For instance, in my study Pelmo was very cautious in the choice of both her verbal and non-verbal conduct, during class discussions to avoid embarrassing her students.

The way a teacher participant in Zembylas’s (2004a) study generated motivation in her students by modelling her excitement about science studies reinforces my findings related to student motivation and encouragement. Pelmo encouraged students to participate without hesitation through her openness, being very articulate while interacting and revealing her mistakes. Such synchronisation of interest between the tutor and students and shared mood in a science lesson enabled them to create healthy relationships which ultimately facilitated effective learning and teaching of science.

In summary, the relationship between teachers and students in the class is the crux of the classroom EC. To sustain a positive EC it is important for teachers to recognise and develop healthy relationships to generate successful interactions between the teacher and students.
7.5 GENERATING NEGATIVELY VALENCED EMOTIONAL CLIMATE (LOW EC) IN SCIENCE TEACHER EDUCATION

Against the backdrop of the successful activities discussed in Section 7.4 there were a number of activities/rituals that led to a negatively valenced EC or decrease in EC. These included formal lectures, presentations led by unprepared student presenters, students interrupting the flow of the lesson, the tutor denying students opportunities to participate in classroom activities, the tutor failing to meet the academic needs of students, and the tutor not showing up to the class at the scheduled time.

Formal teaching (lecture session) resulted in negatively valenced EC or decrease in EC. During lecture sessions, students showed low emotional energy where they simply responded to the tutor’s questions. This is consistent with Bellocchi et al.’s (2013) findings that during formal discussions on the educational implications of the topic discussed in the class debates, there were fewer cases of laughter and mutual focus on the task, resulting in low emotional energy.

Tobin et al. (2013) contend that when the class was led by a teacher the EC was relatively low and the verbal interactions were univocal with the teacher asking a question, and evaluating the adequacy of the responses given by students. The presence of effective interactions between the teacher and students in the class are a part of social functioning and the absence of these does not foster inquiry (Lemke, 1990). Becker (2000) examined the critical role of students’ questions in literacy development in the US and expressed concern with low number of students asking questions in the classroom. He posits that students’ cognitive (e.g., revealing what they know, don’t know, and want to know), social (e.g., seeking views of classmates
and negotiating group activities), and emotional (e.g., sharing success and failures) growth are weakened when they do not ask questions.

The findings of Tobin et al. (2013) showed that students hesitate to get involved in class activities for fear of being reprimanded by the teacher for giving the wrong answer. This supported my finding that students hesitated to speak or express their opinions for fear of being ridiculed by the tutor or their peers. My other finding that was supported by Tobin et al.’s (2013) study was related to the tutor ignoring students’ remarks or queries. For example, there were instances where Pelmo consciously or unconsciously ignored students’ comments and clarifications just as the teacher in Tobin et al.’s study sometimes did. Another commonality between that study and my findings was that Pelmo became irritated when students gave choral responses or became inattentive and this resulted in less successful interactions.

Negatively valenced emotions were aroused during formal lectures, when the tutor failed to provide academic support to students, the tutor did not show up, and when students were unprepared for their presentations. These quickly spread throughout the whole class resulting in episodes of negative EC or low EC.

The observations and analyses of the characteristics of activities that produce negative emotions are important because if we want to produce and retain high quality teachers in schools, we should adopt pedagogies that are associated with positive emotions rather than negative ones that shut down possibilities for new pedagogies (Zembylas, 2002). My study has identified a series of classroom factors associated with negative EC that can inform practitioners about the kinds of activities and interactions that do not foster a positive learning environment.

The study successfully applied Turner’s (2007) sociological construct of emotions to identify in the moment emotional states during classroom interactions of
a science class. The extension of the application of this sociological theory in the assessment of interactions in science classrooms has the possibility of providing teachers and researchers with better access to theoretical constructs that can assist them in transforming negatively valenced emotional events into positive experiences that will mutually benefit both teachers and their students (see Ritchie et al., 2011). Teachers, especially beginning teachers, should realise the need for redirecting their focus from pedagogies such as lecturing which produce flat or negative emotional events and fail to meet expectations of students, to pedagogies that are more likely to meet such expectations. Teachers could become more receptive to student disinterest and dislike of activities, as observed in this study, from the students’ bored facial expression, lack of synchronised body moments, and the absence of eye contact during a teacher driven class. These emotional cues could help teachers to act differently and re-generate positive emotional energy in their class.

7.6 A WAY FORWARD – ENABLING CONDITIONS

As discussed in Chapter 3, Metiu and Rothbard’s (2012) model of group engagement processes explains how mutual focus of attention among participants is generated in the presence of factors such as a task bubble - barriers to outsiders, task-related artefacts, and shared emotion that led to the accomplishment of a specific task. The key to the successful interactions among members and to the development of mutual focus of attention were a set of enabling conditions including individual engagement, compelling directions, informal interactions, and frequency of interactions. The analysis of classroom events in my study recognised several factors that affected classroom EC positively in the presence of numerous enabling conditions thus reinforcing Metiu and Rothbard’s (2012) group engagement process
model to represent the production of EC in classroom contexts. The modified model is shown in Figure 7.1.

**Figure 7.1.** A model representing the process of generation of mutual focus of attention and shared emotion from numerous classroom interactions fuelled by certain enabling conditions leading to positively valenced classroom EC. Adapted from “Task Bubbles, Artefacts, Shared Emotion, and Mutual Focus of Attention: A Comparative Study of the Microprocesses of Group Engagement,” by A. Metiu and N. P. Rothbard, 2012, Organization Science, 24, p.8.

Analysis of classroom events identified five factors that affected the classroom interactions positively as seen in Figure 7.1. These were i) task related artefacts, ii) informal activities, iii) coteaching, iv) humour, and v) the tutor providing support to students. Successful interactions resulting from the presence of these 5 factors were more likely to unfold in the presence of several enabling conditions (at the left in Figure 7.1) such as: individual engagement, frequency of interaction and informality of interaction, cogens and presence of resources. My study reinforced three of the four enabling conditions identified by Metiu and Rothbard’s model (i.e., individual engagement, frequency of interaction, and informality of interactions) and added two
new conditions (i.e., cogen and presence of resources) to the model as indicated by the unshaded boxes at the left hand-side of the diagram in Figure 7.1.

In Figure 7.1 the elements within the dashed circle under the title *classroom interactions* refer to factors specific to each interaction. The elements that are to the left of the circle are enabling conditions that contribute to the possibility of the interaction occurring and being characterised by mutual focus of attention and positive emotional energy. How each component of the model generates successful interactions leading to positive classroom EC is discussed in turn below.

### 7.6.1 Individual engagement

Individual engagement was vital in enabling group interactions because only people who were deeply involved with their individual tasks could contribute to the various subsequent interactions (Metiu and Rothbard, 2012). Similarly, in support of the above statement Bellocchi et al.’s (2013) study report that an important factor in the success of rituals is the intensity of the emotional experience experienced by an individual as expressed below:

> The emotional energy experienced by individuals during social interactions is fuelled by and in turn fuels collective emotional experience—or EC—of the group. Individuals will then seek to reproduce successful interaction rituals in future interactions in order to reproduce positive emotional energy. (p. 531)

In my study, strategies such as group activity, interactive sessions, humour, and sessions led by student presenters evoked individual student engagement in interactions which led to further successive interactions. My observations suggest that mutual focus of attention was both an outcome and a stimulus of student engagement in the interactions. In particular, there were instances in my study where students experienced successful interactions that led to positive shared emotions such
as expressing a sigh of relief or smiling after leading a session, presenting a video clip, or explaining certain phenomena scientifically using a video clip or chalk board. For instance, one student expressed his positive emotion after a successful stint with his video presentation as detailed below:

> When I was showing video clips on Newton’s Laws of Motion, I sensed that my friends were happy as I could see smiles on their faces and they were concentrating on what I was showing on the screen. So from that I can say that they were interested in what I was presenting. That time I also felt happy and interested to display the video clip and initiate discussions. (Personal Interview)

This example shows how the joy of accomplishing a task, sharing success, and feeling one’s own sense of worth can be motivating and refreshing (Haidt, 2000). Similarly, Collins (2004) argued that after a successful interaction ritual, participants walk away with increased levels of energy and confidence, whereas, after an unsuccessful ritual, they feel emotionally worn out.

### 7.6.2 Frequency of interactions and informality of interactions

One condition that enabled students’ engagement in my study was the frequency of interactions between peers. As the frequency of interactions among students increased, it appeared that there was greater mutual focus of attention, and shared emotions. For instance, the class EC was positively valenced during certain activities (e.g., group activity, interactive class, and student led class) because during these activities interactions between students were more frequent. Conversely, activities such as formal lectures were characterised by infrequent interactions between peers resulting in fewer instances of mutual focus of attention and shared emotions.
My findings supported Metiu and Rothbard’s (2012) ethnographic study of two software firms. The firm which had frequent interactions between the participants was able to sustain a high number of instances of mutual focus of attention that were required to achieve collective progress on group tasks. In contrast, infrequent interactions in the other firm resulted in fewer instances of mutual focus of attention and shared emotion among its members. Ultimately, the second firm was shut down and members moved to other projects. The rate of interactions between individuals in a workplace can be an indicator of successful interactions because participants are more likely to reproduce the structures that lead to success (Collins, 2004). This shows that interactions have the potential to stimulate mutual focus of attention and shared mood around a task.

The other factor that generated interactions and a high level of mutual focus depended on the type of interactions that occurred (Metiu & Rothbard, 2012). My study shows that there were more successful interactions and emotional entrainment during informal or spontaneous conversations rather than formal instructional rituals such as initiate-respond-evaluate pattern of classroom talk (Lemke, 1990). For instance, as reported in (section 5.2.3 - Extracts 5.3 and Figures 5.11 a and b) informal debates that arose during group discussions invited the expression of diverse opinions and views of students, affording the tutor the opportunity to clarify doubts leading to mutual focus of attention and shared emotions. Other examples of successful interactions included (see section 5.2.3 - Extracts 5.4 and 5.5; section 5.3.2 - Extracts 5.7 and 5.8; section 5.2.6 - cogen transcript S4 and tutor, Figures 5.17, 5.18a and 5.19a). The informality of certain types of classroom interactions made students feel comfortable to share ideas, and express enthusiasm and doubts.
openly. Such informality made it easier for students to initiate or join focused interactions.

Conversely, formal interactions were characterised by information dissemination as opposed to the types of back and forth exchanges that led to mutual focus of attention during informal classroom encounters. For instance, during formal lectures the mean EC during discussions was below average to low positive range (EC range=2.7–3.4) and there were fewer opportunities for students to interact with each other (see section 5.2.4 - interview transcript S7 and Figures 5.13 a and b).

An interesting implication of this could be to suggest the adaptation of the less formal structure during more “content” focussed sessions. For example, students could be invited to suggest their first thoughts about an issue that eventually gets resolved more formally.

In summary, informal interactions were characterised with exchanges of ideas among students and with their tutor leading to mutual focus of attention and positive EC. In contrast, formal interactions were characterised with information dissemination with little room for group processes.

7.6.3 Cogenerative dialogue

As expressed earlier cogen forms one of the two new enabling conditions identified in my study. Cogen enhanced mutual focus of attention among students and their tutor leading to shared emotion and ultimately translating to positive class EC.

Cogen served two purposes in my study; namely, to diagnose what went well in the class and what did not go well and to devise intervention strategies collaboratively for addressing any issues within the class. However, the success of cogens depends on the redistribution of power among students and the tutor. This
was a challenge initially because the hierarchical society in Bhutan expects students to show respect for their teachers so students rarely dare to talk to their teachers openly, and never consider challenging their authority.

Cogens provided students with opportunities to talk openly about specific lessons including pedagogy, content and the classroom proceedings in general (Roth, et al., 2000). The cogen dialogues were structured so that all participants felt free to speak openly with equal turn taking, active listening, and sharing of responsibility among students and the tutor. These discussions helped to minimise the power differences between students and the tutor as they amicably discussed future actions and activities for improvements to the quality of future science lessons.

As cogens became more frequent, students participated more readily with their contributions mutually focussed on improving the learning environment. This type of prolonged dialogue emotionally connected the tutor and students by building mutual trust and a sense of belongingness. For instance, the tutor expressed that the cogen exercise has helped students to be more confident and interactive in the class discussion. The tutor further believes that they showed maturity in their presentation and are more critical in their thoughts and actions. It also brought her closer to the students.

The tutor also highlighted the role of cogen as a pedagogical tool when she expressed that cogen made her a better tutor by reflecting on the feedback given by students and improving on her pedagogical practices that put students in a disadvantaged position.

In my study the process of cogen helped narrow the gap between the tutor and students. The tutor whom students regarded as a commanding figure early in the study had become their mentor and a guide later. In conclusion, cogens provided a
platform for the students and the tutor to interact across the boundaries of gender, age, ethnicity, and status. In the process of discussion, participants learnt to create successful interactions across those boundaries. As discussed in Chapter 6 this renewed relationship helped the tutor and students to discuss mutually things that worked in the class and innovate new strategies to improve practices that were deleterious for the class. Cogen can be regarded as activities with high transformational potential.

7.6.4 Presence of Resources

The second enabling condition that increased mutual focus and shared emotion among students in my study is the availability of resources. The result of the study indicates that the presence of relevant resources is vital for the production and sustenance of mutually focused interactions because resources help participants to engage and to share a common mood. For example, when video clips or models were displayed, students were found leaning forward with their gaze fixed on the screen, attentive to the explanation of a scientific concept through video animation, collective laughter generated from the funny video animation, or presentation of a scientific model by their friends. Moreover, students also worked closely when involved in group activities sharing marker pens to write on the chart paper, reading documents together, and sharing a laptop to prepare presentations.

On the contrary, lack of resources adversely affects the classroom interactions. Though the Case College of Education is one of the premier colleges in the country, it has limited access to resources currently in use in most high schools around Bhutan. In this study, there was a case of students failing to complete the assigned task or failing to understand a scientific concept because of limited copies of article in the group (see section 6.3 - assertion 2, interview transcript S27) and
summer heat taking its toll on the students in the classroom (as detailed in section 6.3 - assertion 2, interview transcript S7).

In another situation, the tutor was concerned when she saw not many of the students had the textbook. To get the planned class discussion going, she managed to provide at least one textbook for every group by borrowing books from those groups which had two or more.

Similarly, the lack of facilities like air conditioners in the classroom also affected student performance in the class. For instance, one student uttered “I hate afternoon classes as it is too hot and we feel bored and cannot concentrate” (S12). Similarly Student 4 expressed “the summer heat of Samtse is making us feel drowsy and lazy.” The matter got worse when there was load shedding because the ceiling fans ceased to function and moreover, it disrupted the flow of the class presentation as the room gets dark and also the presenters cannot make reference to PowerPoint slides. During one lesson (lesson 22), the light went off and the class plunged into darkness. The only sound that could be heard was the video commentary from the laptop with no visuals. Students could be seen nodding off during this episode.

7.7 CHAPTER SUMMARY

My central argument in this thesis is that the quality of science teacher education can be improved by cogenerating strategies to enhance the success of classroom interactions that lead to positive EC. The most important finding of this study was that the types of activities and relationships developed between the tutor and students mattered most to participants in that they were the principal enabling conditions for successful classroom interactions and positive EC. Among the different activity forms, students reported positive EC in those lessons that were hands-on (video clips and models) and those that were informal in nature (group
activity, interactive session, students leading a session [coteaching]), whereas negative EC or low EC was reported in those that were purely formal or less engaging such as teacher dominated lecture.

This study made three important contributions to the field of emotional research in pre-service science teacher education. Firstly, my study contributes to the field of emotional research in pre-service teacher education by opening new windows into the effects of teaching-learning activities in the context of teacher education. My results confirm the findings of Bellocchi et al. (2013) and Tobin et al. (2013) that events shape class EC. In my study, events such as use of video clips, models, humour, and student-led classes, improved EC. This extends our understanding of the factors that affect classroom EC in teacher education that developed in prior studies.

A second contribution my study makes is that this is the first study of its kind in the Bhutanese context. This study also helps to address the issue of poor teacher quality education raised by the Education Sector Review Commission [ESRC] (2008) and VanBalkom and Sherman (2010). The ESRC (2008) suggests that teaching and learning in Bhutanese schools typically occurred within a culture of passivity, with the teacher dominating the class. The responsibility of spearheading such a reform falls on the Colleges of Education. However, how can one think of producing quality and emotionally balanced teachers when approximately 70% of lecturers from the two colleges of education were actually unhappy with the system (VanBalkom & Sherman, 2010)? One way to improve teacher quality is to improve pedagogy in teacher education. This study reports the students responded well to the particular strategies identified through cogen. The interactive sessions invited students to provoke each other through questions which created opportunities for
fostering positive EC, video clips to supplement students understanding of the scientific concepts, and coteaching to afford students opportunities to accept responsibility for their own learning.

The cogen exercise also helped diagnose classroom practices that were both positive and deleterious for the class. Cogen also helped in narrowing the gap between the hierarchical position of the tutor and students. The tutor whom students regarded as an authoritative figure early in the study had become their guide and facilitator by the end of the study. This improved relationship helped the tutor and students to discuss and come up with new pedagogies collegially to redeem the practices that were detrimental for the class.

Pre-service science teachers should be encouraged to replicate coteaching and cogen activities in their own future classes. It is also suggested that pre-service science teacher educators would benefit from becoming aware of their class EC to initiate positive interactions when EC is low or negative (see Chapter 5) in their future classes. With such activities (coteaching and cogen) well used, teachers could successfully facilitate the learning of science in schools that lead to greater teacher satisfaction and help reduce teacher attrition.

The third contribution made by this study is that emotions shape the learning process for both the teacher and students and so it is imperative for the teachers to acquire skills to read the emotions experienced by students as well as collective states of emotional arousal - or emotional climate (EC) - of their classes (see Bellocchi et al., 2013), so that the teachers can adjust their practice appropriately (Hargreaves, 2000).

This study identified the types of interactions in science classes that generate positive EC and negative EC or low EC at the micro-level. The classroom structures
that valence the classroom EC positively can be reproduced by teachers and professors at their schools and colleges respectively to create positive ECs in their science classes.

The study also makes four important theoretical advances in science teacher education. The first theoretical contribution made by this study is that it adapted Metiu and Rothbard’s (2012) group engagement model and reinforced three of the four enabling conditions and proposed two additional conditions. Their model elucidates how the process of group engagement leads to mutual focus and shared emotion among members of software developers based on several elements fuelled by certain enabling conditions such as individual engagement, compelling direction, informal interaction style, and frequency of interaction. The two additional enabling conditions are cogen and the presence of relevant resources which can enhance mutual focus and shared emotion as discussed in Section 7.6, Chapter 7 and further re-emphasised in Section 8.3, Chapter 8.

The second theoretical contribution made by this study is that it articulates two enabling conditions for positive EC. The enabling conditions are the need for the presence of relevant resources to support interactions, and the use of cogen, which can trigger successful interactions. My study revealed that the presence of relevant resources is critical for the success of interactions, so that the student has the support they need to progress with their learning and not get distracted by a lack of resources. Cogen as an enabling condition, helped the teacher and students to come together with an equal footing in pursuit of identifying and evaluating what worked and to suggest intervention strategies to redeem practices that disadvantaged students (Tobin & Roth, 2006).
A third theoretical contribution of my study is to confirm Collins’ (2004) work on interaction rituals. Though this study was conducted in a different setting with students coming from different cultural backgrounds, it documented similar findings to that of prior studies conducted in English speaking countries that have drawn an interaction ritual theory to explain classroom happenings (Bellocchi et al., 2013). Collins’ work on interaction rituals was a useful lens to apply to this different cultural context. Moreover, my study highlights the importance of activities (such as video clips and models, interactive sessions, group activity, & coteaching) and relationships between students and the tutor generated through humour and the tutor assisting students in their work, in helping to gain mutual focus of attention on a task and shared emotion. My study further affirms that the presence of artefacts (e.g., video clips and models) enabled the production and sustenance of mutually focused interactions because it helps participants to engage and to share a common focus of attention. For instance, once the students focussed their attention on certain activities they were less distracted or side tracked by the presence of outsiders in their classroom.

The fourth theoretical contribution made by this study was to confirm two of Turner’s (2007) 17 principles of the sociology of emotions in different cultural context. My study illustrates how the teacher and other students experienced positive emotional arousal (happiness) when their positive expectations (e.g., students using video clips to supplement their presentation) were realised.

The video clip helped students to understand scientific concepts and to link theory with practice. The tutor also appreciated students using video clips to explain how certain Physics principles work. Video clips had saturated an entire lesson with positive EC which has helped students sustain their interest for the remaining period.
of the class. The tutor and other students also applauded and credited some of the presenters for such initiative. The overall class average EC was positive for the lessons which had video presentations, but the interval which had the video presentations had high emotional intensity. The overall positive class average EC of those lessons may be attributed to short video presentations which are of high emotional intensity. This reinforces the first principle of the sociology of emotions namely:

when expectations for self, others, and situation are met in an encounter, individuals will experience mild positive emotional arousal and will be more likely to give off positive sanctions to others [e.g., tutor and others sanctions Singey through applause in lesson 15 interval 13] … and if they had some fear about expectations being met, they will experience more intense variants and elaborations of positive emotions. (Turner, 2007, p. 200)

One incident that underpins Turner’s third principle “i.e., when expectations for self, other, and situation are not met in an encounter, individuals will experience one or more negative emotions” (p. 201) includes an event from lesson 4 (see section 6.3 - assertion 2 cogen transcript S7 and Tutor, and Figure 6.6) where Pelmo, the tutor, expected her students to enjoy reading an article titled *Team testing* and anticipated a healthy discussion. But, to her surprise, students failed to understand the article and the discussion did not happen as expected which irritated her. As a result from the subsequent lesson she did not encourage students to read the article because of a lack of success in her first attempt. Similarly, another incident which confirmed Turner’s third principle was when, one student, Samphel, failed to lead the class presentation and initiate discussions as expected by the tutor and his friends. (refer section 5.2.5 - assertion 1.5 interview transcript S6 and Figure 5.15). He was one of the brightest students in the class and much sought after by his friends and the tutor for his intelligence and critical answers to questions. As Samphel made his
apology statement for not having prepared his presentation, his voice trembled and he stumbled over his pronunciation. His body bent toward his left and tensed facial expression indicated his lack of confidence and readiness. In this case, the expectations of the tutor and other students that Samphel’s presentation would be insightful and interactive were not met. This incident could be accounted for low average EC (3.3) for the lesson (i.e., lesson 17) through emotional contagion as the class became infested with low emotional intensity.

My study revealed that the type of activities students involved in and the relationship between students and with their tutor valences the classroom EC. For instance, there were instances where the students and their tutor got entrained into laughter or to a lecture by a funny video animation or the rich description of scientific principles articulated by the presenters using video clips and scientific models. Other activities such as group activity and whole class interactive sessions also generated mutual focus of attention on the assigned task and shared emotion after having successfully accomplished a task. Conversely activities associated with formal lecture and presentations led by unprepared presenters resulted in univocal interactions and negative EC or low EC.

Similarly, events such as humour and the tutor supporting students’ work developed a healthy teacher-student relationship leading to positive EC whereas events such as the tutor failing to meet academic needs of students, interruptions from students, and the tutor not showing up to the class valenced the class EC negatively as detailed in Chapter 5. Therefore, it is desirable for science teachers and science educators to trial those activities that generated positive EC in their science classes and avoid those activities that are deleterious to the generation of successful interactions.
Chapter 8: CONCLUSION

8.1 INTRODUCTION

There are a myriad of reasons for exploring classroom emotions. Although there are multiple factors that can be attributed to students’ academic risk, negative emotions associated with learning could be a major reason for students’ disengagement, withdrawal, and failure in science (see Ritchie et al., 2011; Tobin et al., 2013). One approach that offers hope for improving students’ achievement in science is by considering the emotional climate (EC) of a science class. This study investigated the nature of the EC of a B.Ed pre-service science education class at a Case College of Education, Royal University of Bhutan (RUB).

As discussed in Chapter 3 both teachers (Carlyle & Woods, 2002) and students (Sanders, 2009) engage in emotional work as they interact in educational settings. Teacher-student communication behaviours substantially contribute to the EC of the classroom (Titsworth, Quinlan, & Mazer, 2010). For instance, in the course of interactions students develop emotional valences toward learning as a result of behaviours exhibited by the teacher, other students, and various activities undertaken in the class (Honeycutt, Nasser, Banner, Mapp, & DuPont, 2008). Interactions can also facilitate development of relationships between the teacher and students. An emotionally supportive environment helps in promoting desirable outcomes such as a good rapport between people, more coping strategies, and improved emotional health (Burleson, 2009).

In Australia, a small body of research on emotions in a school science class confirmed that the generation of laughter in the class helped students learn science (Roth et al., 2011). Ritchie et al.’s (2011) case study of a grade 7 science teacher
shows evidence of the relationship between emotions and teaching and learning of science. Similarly, another study with Australian pre-service teachers showed a connection between EC and the quality of experiences for the class (Bellocchi et al., 2013). Chapters 1 and 2 established a need to explore further the role played by emotions in learning to teach science and how science teachers’ emotional experiences affect their teaching practices. Against this background, the following two research questions were investigated in a Bhutanese pre-service science teacher education class:

1. What affects the emotional climate in a science classroom for pre-service teachers?
2. How do pre-service teachers respond to interventions to improve the emotional climate of a science class?

Sociological theories on emotion and interaction advocated by Turner (2007) and Collins (2004) provided lenses to help understand the production of EC in a pre-service teacher education science class.

In this final chapter, the results from the study are summarised in Section 8.2 and the significance of the study is outlined in Section 8.3. The implications of these outcomes for teacher education are discussed in Section 8.4. This leads to the limitations of the study and an identification of recommendations of further research in Section 8.5 and finally future directions for science teacher education in Bhutan is proposed in Section 8.6.
8.2 SUMMARY OF RESULTS

The following six assertions, as they relate to each research question, framed the thesis for this study:

**Research question 1: What affects the emotional climate of a science classroom for pre-service teachers in Bhutan?**

Assertion 1: The valence of emotional climate depended on the type of activity in which classroom participants were engaged.
Assertion 2: The valence of emotional climate depended on the type of relationship structure present in the classroom.

**Research question 2: How do pre-service teachers respond to interventions to improve the emotional climate of a science class in Bhutan?**

Assertion 1: The tutor’s use of encouragement improved students’ participation and time management.
Assertion 2: Students’ participation and time management improved during student-led lessons (presentations).
 Assertion 3: Students’ participation and time management improved during lessons that involved students presenting video clips.
Assertion 4: Lessons associated with humorous moments improved student participation.

The thesis of this study is that the types of activities students are engaged in and the relationships developed between the tutor and students mattered in bringing about successful classroom interactions and positive classroom EC. Presentation activities (i.e., student-led sessions [coteaching] and sessions that referred to video clips and models) and informal activities (e.g., group activity and interactive whole class discussion) generated high levels of energy. During these successful sessions
there was synchronisation of body movements and eye contact with the audience, and students reported confidence to interact with a group or class.

Humorous moments and the tutor’s concern for students’ work developed the tutor-student relationships encouraging open interactions between them. Based on the findings of this study, I propose it is necessary to establish particular enabling conditions for the production of positive EC in Bhutanese science teacher education classes. These conditions include:

i. individual engagement that is both an outcome and stimulus of classroom activities and student-tutor relationships

ii. higher frequency of classroom interactions that enhance the likelihood of generating and sustaining mutual focus of attention and shared emotions among participants

iii. classroom interactions that are less formal and encourage diverse and frank discussions between participants

iv. use of cogen to transform classroom practices by reducing power differences between students and the tutor to make learning a collaborative venture

v. improving participants’ access to resources relevant to the topic to ensure support for the other enabling conditions.

8.3 SIGNIFICANCE OF THE STUDY

The study makes four important theoretical advances in science teacher education. Firstly, my study adapted Metiu and Rothbard’s (2012) group engagement model and strengthened some of its enabling conditions and contributed two additional enabling conditions. Secondly, the study articulate two new enabling conditions for producing positive EC that extends the conditions originally proposed by Metiu and Rothbard (2012). These two new enabling conditions were the need of
individuals to gain access to relevant resources and to engage in cogen to transform classroom practices. Thirdly, my study confirms the relevance of the principles of emotional arousal in that it documented similar findings to those of previous studies on emotions conducted in Western contexts (Bellocchi et al., 2013; Ritchie et al., 2011; Tobin et al., 2013). The fourth theoretical contribution was that two of Turner’s (2007) 17 principles were confirmed in this different cultural context. Namely these were, principle 1 (e.g., the tutor and others students applauding Singey [positive sanction] for clarifying a scientific concept using video clips) and principle 3 (e.g., the tutor getting irritated [experience negative emotion] when students failed to understand the article “Team testing.”

This study has also made three important contributions that confirm and extend previous empirical research in science education. The first contribution my study made was that this was the first study of its kind in the Bhutanese context to report students’ evaluation of EC on an in the moment basis using clickers and cogens. The second contribution the study has made is it has confirmed the findings of Bellocchi et al. (2013), Ritchie et al. (2011) and Tobin et al. (2013) which reported that events shape class EC. For instance, events such as presentation of video clips and models generated positive EC in my study. The third contribution made by this study was the identification of interactions in a pre-service science teacher class that valence EC of the science classes positively and negatively at the micro-level. Knowledge of the structure of interactions that produce positive and negative EC can inform other science educators who want to reproduce positive ECs in their science classes while reducing negative EC. The implications of this study for teaching and research are discussed next.
8.4 IMPLICATIONS FOR TEACHING AND RESEARCH

8.4.1 Implications for the tutor

In Bhutan, science teaching and learning has always been a problem due to varied reasons. Cultural and traditional beliefs often put teachers in a disadvantaged position. Even in the tertiary institutes most of the teachers still practice traditional methods of teaching (i.e., teacher-centred lessons; Young, 2012) and students meticulously take copious notes from the lecturers only to reproduce them in an exam. Moreover, owing to strong cultural inhibition students seldom question teachers. In Bhutanese culture teachers are revered as highly learned and voicing against them is considered impolite or indecent. The consequence is that Bhutanese students are polite and well behaved but they may avoid applying their reflective and analytical skills.

Just as Vicky, the Australian teacher in a series of classroom studies (Ritchie et al., 2011; Tobin et al., 2013) improved her classroom pedagogy and her teaching by working with researchers, Pelmo’s (tutor) involvement in my research also led to transformations in her pedagogy and her interactions with students which improved the EC of the classroom. Pelmo felt empowered by the research process and the shared understandings that supported her own goals of teaching, which brought changes that developed and maintained a positive learning environment. It was also a learning experience for her especially in terms of research skills. Research is new in our context (Royal University of Bhutan) and many of my colleagues lack research skills. Pelmo expressed that she learnt about ethnographic case study and the process of conducting cogens and interviews through her participation in this research. Pelmo claims that she will use these techniques in the near future. The cogen experience also improved her reflective skills. Following cogens she reflected on her practice
and came up with new strategies to be tried in the following class. This platform brought her closer to the students.

Pelmo’s research experience in the case study class also benefited her other classes. What worked in her research class was replicated in other classes. In fact she posits that the non-research classes subsequently benefitted more, as by the time she applied the new skills to the other classes the skills were more refined. Her involvement in the cogens and discussions with students helped her design new teaching pedagogies such as students leading a session (coteaching), use of artefacts such as video clips to supplement their understanding of science concepts, and her use of humour to explain scientific concepts.

Positive emotional interactions were reported in this study when the above pedagogies were introduced. It is desirable for Pelmo to continue to use these pedagogies in her future classes. She can also share these innovations with her colleagues so that they can trial them in their classes to determine if they generate successful interactions. Other pre-service science educators are encouraged to replicate some of the approaches used by Pelmo in this study if they want to improve the EC of their classes.

8.4.2 Implications for the pre-service teachers
In the five-month research period, most students metamorphosed from shy and introverted students to confident and interactive students. The students have become resourceful and critical in their thoughts, and they began to take greater responsibility for their own learning during the research. Students who seldom raised questions in class had started to question the tutor.

This cohort of pre-service teachers was the first group of teachers in Bhutan to participate in a research project of this nature. By now, they are aware of the role of
emotions in teaching and learning of science. Over the course of this study, the pre-service teachers have encountered several events and incidents in the class that have influenced their classroom activities both positively and negatively. They were also introduced to cogen and its dual role of diagnosing classroom activities that led to successful interactions, positive EC, and collaboratively suggesting interventions to redress activities that led to unsuccessful interactions.

Upon their graduation from the college, these new teachers are expected to bring differences in the quality of science education in Bhutanese schools by reproducing strategies and pedagogies in their classes that generate mutual focus and shared emotions leading to positive EC. It is also hoped that through their emotional lenses they will be able to remove the stigma students have that science is a difficult subject by incorporating humour to facilitate learning of science and making it less intimidating for their students. They may also consider introducing cogen as a part of a professional development process across staff members of their school for harnessing better science teaching and learning.

8.4.3 Implications for the teacher education programs

The key to improving both access to and the quality of education lies in improving teacher education. Our kings and leaders have high regard for teachers. Yet, notwithstanding repeated pay increases for teachers, teaching remains relatively unattractive because prospective high school graduates are granted scholarships to study abroad or opt for other professions in which they perceive to have stronger futures or with more appealing conditions. This problem is particularly acute for science graduates (VanBalkom & Sherman, 2010). The shortages of science teachers have resulted in arts teachers teaching science (Johnson et al., 2008). Science programs in lower grades were content free and did not develop key science ideas.
Moreover, there was a lack of practical work in high school science due to content overload (Johnson et al., 2008).

Many schools in Bhutan are still faced with acute shortages of resources. Science teachers need to be professionally and emotionally equipped to solve creatively the many issues within such schools. These beginning teachers’ emotional woes are exacerbated when they have to teach in diverse (multi-grade), and often difficult, situations (remote location) unless they are well trained and inspired to teach under these conditions.

The current teacher preparation programs at the two colleges of education are also challenged to keep abreast with the demands on teachers. According to the Education Sector Review Commission [ESRC] (2008) report, more than 16000 primary school age students were deprived admission to schools as of 2008 owing to teacher shortages. It is projected that the demand for teachers in Bhutan will soar in the next 10-15 years (RUB, 2006). The lecturers whom VanBalkom and Sherman (2010) interviewed expressed frustration because of poor working conditions and heavy workloads and raised the issue of low morale. These lecturers described a high degree of stress as they are required to teach every day with less time for planning, providing support to students, or engaging in research. This confirms the RUB Strategic Plan (2006) finding that the lecturers at the two colleges of education are heavily burdened with workload and high faculty-student ratios undermine the quality of output, besides causing a general sense of professional burnout.

Drawing from this study, some of the ways to improve teacher education programs could be to reproduce pedagogies that produced successful interactions in the science class at the centre of this study. This could be achieved in part through use of humour to establish relationships between students and the tutor and by
implementing cogens to unravel classroom practises so as to implement intervention strategies to help improve students’ classroom experiences.

### 8.4.4 Implications for Research

The strength of any university internationally lies in its research capacity. Implementation of any new change in teaching and learning should be evidence-based. Research is considered to be the impetus for the development of policies and it helps in the growth of inquiring minds to stimulate students to be innovative and creative through critical thinking. Research is a new focus in Bhutan and, until recently, it did not feature in the teaching-learning process of the institutes. Any new policy changes in the system were based on the ideas of an influential leader and not substantiated by evidence. These policies were met with limited success.

The establishment of the Royal University of Bhutan (RUB) in 2003 provided some hope for research in Bhutan as evident from the Royal Charter and the Statutes of the RUB (2003) which states that one of the main objectives of the university is to “promote and conduct research, to contribute to the creation of knowledge in an international context and to promote the transfer of knowledge of relevance to Bhutan” (p. 3). Discussing the role of research in the university, the RUB strategic plan (2004–2012) also states that, “research is a crucial element of any institution of higher education and without the active involvement of staff in research; no institution can justifiably be recognised as a university” (p. 33).

One potential way forward for improving the standing of science teacher education within RUB is by building research culture in the college. To be able to build a research culture, faculty staff should be encouraged to take up research and help initiate a research culture in the college. When RUB was instituted in 2003 only
one member had a PhD whereas currently, there are 13 staff members with PhD qualifications in different fields (RUB, 2012).

The present study helped me generate hosts of issues pertaining to emotions and EC that are essential to science education and the teacher education system, especially when interacting with beginning teachers. My findings also contributed to the growing body of knowledge of a teacher’s lived experience and understanding of the prevailing EC in her pre-service teacher education classroom. It illuminated the relationships between teacher emotions and interactions in a classroom that influenced the EC of the class. The best practices identified in this study, as reported in (section 7.2, 7.3, and 7.4 - chapter 7) can be replicated in teacher education programs in particular and other programs such as schools, vocational institutes, and other colleges of RUB in general. The success of cogens in this study can also be replicated in other settings to gain a shared understanding between teachers and students about the best practices occurring in the classroom and how less effective practices can be averted.

8.5 LIMITATIONS AND RECOMMENDATIONS

Although this ethnographic case study allowed me to gain insights into pre-service secondary science teacher emotions and classroom EC, nevertheless the study is subject to certain limitations as detailed below.

One of the main limitations of this study is the inability to adopt a more elaborate view of Bhutanese culture. Bhutanese students in general are highly regarded for their desirable conduct in the classroom from the perspective of teachers. In Bhutanese context student conduct encompasses students showing respect to teachers and higher authority which has been passed on through generations. In school, students are expected to maintain a high degree of respect for
the teachers by greeting them with a bow of their head and body slightly bending forward when they meet and rise whenever they communicate with the teachers (Rinchen, 2001). Mehra (1974) posits that Bhutanese are one people who are disciplined, loyal and dedicated to the authority. This cultural trait has meant that students both in schools and tertiary institutes do not participate in classroom discussions and do not speak openly with their teachers. The silence of the students might have had implications to the type of interactions that prevailed in the classroom during my study. The other drawback point is the nature of data collected in this study that was conducted within the unique cultural norms of Bhutan. Classroom interactions that produce class EC may vary in other cultures where the norms of student-teacher rapport are different from those experienced in a Bhutanese context. The other limitation is the students in my study have high regard for Pelmo, their tutor as she was friendly and approachable. The students in this study behaved well and showed a lot of respect for her which may have limited the amount of negative EC or low EC that students reported.

The other shortcoming of case study is ‘since the case study is not an account of the whole but rather a “slice of life” further limited by the sensitivity and integrity of the researcher’ (King, 2009, p. 95). There is a risk of the study getting diluted or blown out of proportion, leading to fallacious conclusions (Burns, 2000). This limitation of case study research was addressed by making explicit connections between the results of my study and those of similar studies in other cultural contexts such as Australia (see Bellocchi et al., 2013; Ritchie et al., 2011; Tobin et al., 2013). Some of the similarities between the class interactions identified in my study and those identified in Australian studies provide encouraging examples of some results that were generalisable across different cultural contexts.
8.5.1 Recommendations relating to further research

This study investigated the events that produced positive and negative EC valences and how students responded to the interventions proposed during cogens. However, I realised that there is further research required. Future researchers should continue to study the EC of science classes and its impact on teaching and learning of science with a special emphasis on the following issues:

- In this study, the students mentioned positive experiences with the use of video clips in comprehending scientific concepts, during interactive whole class discussion in developing mutual focus of attention and shared emotion, and through coteaching in making learning a collaborative venture. Further research is needed to establish whether the positive climate that was generated in science classes during the use of video clips, interactive whole class discussion, and coteaching can be achieved with equal effect in university classes in other disciplines.

- Physics Education modules arguably are conceptually less demanding than Physics content modules. The tutor has the flexibility to use various strategies and incorporate activities while teaching Physics Education modules and these modules have no written exam unlike content modules. Therefore, research should be carried out in Physics content modules to determine whether the level of interactions and EC generated are similar to this study using similar methods.

- This case study involved a female tutor and the students had a lot of admiration for her as they found her frank and approachable. They asserted
that they felt secure in her class because they were comfortable to approach her for help. Students’ perceptions of classroom EC might be influenced by the gender of science teachers. Perhaps if a male tutor was observed this could have affected the nature of classroom interactions and the class EC. A challenge to interested future researchers is to explore EC of classes taught by male Physics teachers to ascertain whether the gender of science teacher matters in the generation of positive classroom EC.

➢ The students who participated in this research were the first group of Bhutanese future teachers to become aware of the importance of emotion in science education. These students are conscious of the classroom practices and pedagogies that valence the EC of the class. Research could be conducted by following these teacher graduates into their beginning years of teaching to investigate their classroom practices and to gauge whether they are able to create positive EC in the school settings as suggested by Bellocchi et al. (2013) in their study.

➢ Because this study was conducted in the Case College of Education located in a semi-urban area the findings cannot be generalised to the other College of Education located in an urban area that has better infrastructure and resources. Moreover, the faculty and students of the other college are more open because of their proximity to the capital city and it being an international port. There is a need to carry out similar studies in the other College of Education to gauge how the location and better enabling conditions affects EC of the class.
This study revealed that the types of activities students engaged in (i.e., video presentation, use of models, group activity, and interactive sessions) and relationship between the tutor and students (i.e., tutor supporting students’ work, use of humour, and coteaching) mattered in generating positive EC in the class. There were only a few incidents where some students indicated that the use of video clips and models in their presentation helped them to understand scientific concepts. Therefore, there is a need to conduct further study to explore in-depth the influence of EC on student’s conceptual learning.

8.6 FUTURE DIRECTIONS

My study presents various factors that affected the nature of pre-service science teachers’ classroom EC. This study provides significant insight into understanding classroom practices that produced different EC valences of the science class. It is evident from this study that there is a lot of work to be done by teacher educators, RUB, schools, teachers, and policy makers, in order to generate and sustain positive EC.

As noted in the earlier chapters, Bhutan’s developmental philosophy is Gross National Happiness. This study plays a small part towards this philosophy as it investigated the EC of pre-service secondary science teachers at the RUB. Education is vital to the realisation of this philosophy but more importantly science education, as it is an instrument of GNH as the quality of science education is central in building human capital especially in the case of Bhutan where science and technology is still at the rudimentary stage. There is a need to challenge the way
science is currently taught in the schools and colleges of Bhutan. Instead of following the existing curriculum and textbooks, a new approach that values students’ views and draws on wisdom of generating successful interactions between the teacher and students should be put in place. Bhutan’s macro-social policy of GNH can only be realised if it reflects happiness that exists between face-to-face interactions among the teachers and students during micro-social processes in the classrooms. Collins (2004) beckons that the macro-social structures are the reproduction of micro-social processes and if happiness is produced during classroom interactions, these structures can support the development of macro-social structures such as GNH.

Another challenge faced by educators in Bhutan is the diffident nature of the Bhutanese students. Their shy demeanour restrains them from interacting with their peers or their tutor and interaction does not happen as expected from a Westernised view of education. The flow of interaction is univocal from the tutor to students. This results in a lack of mutual focus of attention and shared energy among students which translates to a low classroom emotional climate. My study did not adopt a more elaborate view of Bhutanese culture and therefore could not discern to what extent Interaction Ritual Theory is able to account for different forms of interaction in formal educational settings in non-Western cultural contexts. The extent to which this theory can account for interactions in non-Western contexts is a matter for future investigation.

However, the present study suggests that students respond well in a class that has student-led presentations, lessons referring to video clips and models, where interactive sessions involve humour, and where the tutor has a high regard for students. Humour is considered as one of the GNH social traits. GNH social traits are
the positive attitudes that the teachers have for students and vice versa. Positive social traits can lead to good relationships between the teachers and students. Teacher-student relationship is the essence of classroom vitality where the tutor and student support and interact positively with each other in the GNH sense. Activities such as coteaching, cogen, and interactive whole class sessions in my study help establish healthy relationships between the tutor and students such as students respecting tutor’s views and the tutor reciprocating with love and respect for the students’ views which is vital for teaching and learning. In the absence of high quality and supportive teacher-student relationships, a teacher teaches for the sake of teaching and students learn for the sake of learning.

By virtue of its being the first and the only university in the country, the RUB is called upon to set standards for the highest quality of science education and train quality science teachers. The integrity and honour of the university comes from the kinds of graduates it produce, and that of the RUB will be no exception.

The college and school administrators must ensure that they have competent science teachers, who are committed role models and are willing to establish science programs which can encourage students intellectually and emotionally. Experiences and findings from this study indicated the need for competent science teachers to create a good impression of science and to pursue science-related careers. The most forward looking, flawlessly conceived science curriculum matched by adequate resources does not lead to fruition in the absence of qualified science teachers who provide purpose and direction to institutions of learning. However, they should also ensure that the colleges and schools have adequate resources, and that the teachers are provided with small and manageable classes so that they can have more interactions. It is difficult for the teachers to manage big classes as this leads to
formal lectures and a lack of individual attention. In conclusion, teachers must adapt or replicate pedagogies that favour student interactions and positive EC across classes, and evade pedagogies that are deleterious to classroom interactions.

Pre-service teachers and lecturer colleagues of RUB can draw insights from the outcomes of this study that the EC of a class is related to teacher emotions and interactions in a classroom setting. The involvement of the tutor and students in cogen transformed classroom pedagogy by collegially designing innovative teaching pedagogies such as the tutor and students becoming involved in coteaching, the use of artefacts such as video clips and models to supplement their understanding of science concepts, and the use of humour by the tutor and students to explain scientific concepts in their presentation. Their involvement in cogen also improved their reflective skills and interactions between them.

Since transferability depends on ‘similarities between sending and receiving contexts, the researcher collects sufficiently detailed descriptions of data in context and reports them with sufficient detail and precision to allow judgments about transferability’ (Erlandson, Harris, Skipper, & Allen, 1993, p.33). In my study, the sending context is the study location (i.e., Case College of Education [CCE]) and receiving context is the faculty of CCE. Since sending context and receiving context is the same, other colleagues of CCE may apply the outcome of this study in their classes more readily.

The Case College of Education, RUB is in the process of developing science programmes for the Master of Science Education. The study of teacher emotions and science classroom EC will be incorporated into the programme as the study of emotions and EC can inform the pedagogy of the 21st century making the teacher graduates aware of the types of classroom interactions that will generate positive EC.
and negative EC. The use of cogen can also be used both as a pedagogical tool and diagnostic tool. As a diagnostic tool the tutor and students can collegially discuss the affordances and constraints of pedagogy and classroom environment we co-habit and come with intervention strategies to overcome such shortcomings.
REFERENCES


Warren (Eds.), *Teaching mathematics in new times* (pp. 397-403). Brisbane, Australia: Mathematics Education Research Group of Australasia Inc.


# APPENDICES

**Appendix A: 10 Modules of Physics**

<table>
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<tr>
<th>Sl. no</th>
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<td>Mechanics</td>
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<td>3</td>
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<td>Optics and Waves</td>
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<td>Electronics</td>
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Appendix B: Turner’s (2007) 17 Principles of Human Emotions

1. When expectations (for self, others or the situation) are met, mild positive emotional arousal will be experienced. If an individual was somewhat fearful that expectations would not be met, they will experience more intense variants of positive emotions if expectations are realised.

2. The clearer the expectations are, the more likely the expectations will be met.

3. When expectations (for self, others or the situation) are not met, negatively valenced emotions will be aroused.

4. When individuals perceive that they have received positive sanctions from others, they will experience positive emotions and be more likely to give off positive sanctions to others. This mutual flow of positive sanctioning can increase synchronisation of talk and body language, and feelings of group solidarity.

5. When individuals perceive that they have received negative sanctions from others, they will experience negative emotions.

6. When individuals experience positive or negative emotional arousal they make attributions about the cause of their emotional experiences.

7. Transactional needs generate expectation states in an encounter.

8. If transactional needs are not met, individuals will experience negative emotional arousal.

9. The clarity of expectations is directly related to the meso-level structure within which an encounter occurs.

10. The use of similar language will influence the verification of each individual’s role in an encounter.

11. If individuals understand each other and what is happening in an encounter, transactional needs are more likely to be met.

12. If individuals do not understand each other and what is happening in an encounter, transactional needs are less likely to be met.

13. If self is highly salient, more intense emotions may be aroused in interactions.

14. If an encounter is deeply embedded in meso-level structures (and the meso-level structures are deeply embedded in macro-level structures), the more intense the emotional arousal will be.
15. If encounters within a meso-level structure are consistently positive, individuals are more likely to develop a commitment to the structure and culture of the meso-level structure.

16. If encounters within a meso-level structure are consistently negative, individuals are less likely to develop a commitment to the structure and culture of the meso-level structure.

17. The more individuals experience anger, the more likely they are to make external attributions to macro-level structures.
Appendix C: Interview Protocol – Student

A. Positive Climate

Question 1

i. Can you recall a moment or experience of positive emotions in class?
ii. Can you tell me about those experiences?

Question 2

i. Can you recall lessons that were very positive for the class?
ii. Please tell me about those lessons?
iii. What made them positive?
iv. How did you know the class was positive?
v. How did you feel during this lesson?

B. Negative Climate

Question 1

i. Can you recall a moment or experience of negative emotions in class?
ii. Can you tell me about those experiences?

Question 2

i. Can you recall lessons that were very negative for the class?
ii. Please tell me about those lessons?
iii. What made them negative?
iv. How did you know the class was negative?
v. How did you feel during this lesson?
Appendix D: Interview Protocol – Tutor

A. Positive Climate

Question 1

i. Can you recall a moment or experience of positive emotions in class?
ii. Can you tell me about those experiences?

Question 2

i. Can you recall lessons that were very positive for the class?
ii. Please tell me about those lessons.
iii. What made them positive?
iv. How did you know the class was positive?
v. How did you feel during this lesson?

B. Negative Climate

Question 1

i. Can you recall a moment or experience of negative emotions in class?
ii. Can you tell me about those experiences?

Question 2

i. Can you recall lessons that were very negative for the class?
ii. Please tell me about those lessons.
iii. What made them negative?
iv. How did you know the class was negative?
v. How did you feel during this lesson?

C. Stimulated Recall Interview

i. In certain occasions you use native language (Dzongkha) as a part of your conversation or lecture. Why?
ii. On few occasions you left class early and sometime you extend your class behind schedule. Your views.
iii. You often check time (class time) with your students. Your opinion.
iv. How do you feel when the questions or doubts raised by students in the class remains inconclusive/unanswered?
v. You did not turn up in one of the classes. Your views.
D. Observations

i. What is your experience being with these students for the last one year?
ii. What difference do you notice in the class taught by you and when students carry out presentation?
iii. Does this research experience help you in the enrichment of your lesson delivery?
iv. Do you think students showed improvement (any aspect) as a result of this research?
Appendix E: Approval Letter from the Queensland University of Technology

University Human Research Ethics Committee
HUMAN ETHICS APPROVAL CERTIFICATE
NHMRC Registered Committee Number EC00171

Date of Issue: 10/4/13 (supersedes all previously issued certificates)

Dear Mr Sonam Rinchen

A UHREC should clearly communicate its decisions about a research proposal to the researcher and the final decision to approve or reject a proposal should be communicated to the researcher in writing. This Approval Certificate serves as your written notice that the proposal has met the requirements of the National Statement on Research involving Human Participation and has been approved on that basis. You are therefore authorised to commence activities as outlined in your proposal application, subject to any specific and standard conditions detailed in this document.

Within this Approval Certificate are:
* Project Details
* Participant Details
* Conditions of Approval (Specific and Standard)

Researchers should report to the UHREC, via the Research Ethics Coordinator, events that might affect continued ethical acceptability of the project, including, but not limited to:

(a) serious or unexpected adverse effects on participants; and
(b) proposed significant changes in the conduct, the participant profile or the risks of the proposed research.

Further information regarding your ongoing obligations regarding human based research can be found via the Research Ethics website http://www.research.qut.edu.au/ethics/ or by contacting the Research Ethics Coordinator on 07 3138 2091 or ethicscontact@qut.edu.au

Project Details

Category of Approval: Human non-HREC
Approved From: 14/10/2011
Approval Number: 1100001404
Approved Until: 14/10/2014 (subject to annual reports)
Project Title: A study of the emotional climate of science classes for pre-service teachers in Bhutan
Experiment Summary: Explore the emotional climate B. Ed science class.

Investigator Details

Chief Investigator: Mr Sonam Rinchen
Other Staff/Students:
Investigator Name       Type       Role
Prof Stephen Ritchie    Internal   Supervisor
Dr Vinesh Chandra      Internal   Supervisor

Participant Details

Participants: Approximately 30
Location/s of the Work: College of Education, Samtse, Royal University of Bhutan

RM Report No. E801 Version 4
Specific Conditions of Approval:
No special conditions placed on approval by the UHREC. Standard conditions apply.

Standard Conditions of Approval:
The University's standard conditions of approval require the research team to:

1. Conduct the project in accordance with University policy, NHMRC / AVCC guidelines and regulations, and the provisions of any relevant State / Territory or Commonwealth regulations or legislation;

2. Respond to the requests and instructions of the University Human Research Ethics Committee (UHREC);

3. Advise the Research Ethics Coordinator immediately if any complaints are made, or expressions of concern are raised, in relation to the project;

4. Suspend or modify the project if the risks to participants are found to be disproportionate to the benefits, and immediately advise the Research Ethics Coordinator of this action;

5. Stop any involvement of any participant if continuation of the research may be harmful to that person, and immediately advise the Research Ethics Coordinator of this action;

6. Advise the Research Ethics Coordinator of any unforeseen development or events that might affect the continued ethical acceptability of the project;

7. Report on the progress of the approved project at least annually, or at intervals determined by the Committee;

8. (Where the research is publicly or privately funded) publish the results of the project is such a way to permit scrutiny and contribute to public knowledge; and

9. Ensure that the results of the research are made available to the participants.

Modifying your Ethical Clearance:
 Requests for variations must be made via submission of a Request for Variation to Existing Clearance Form (http://www.research.qut.edu.au/ethics/forms/hum/var/var.jsp) to the Research Ethics Coordinator. Minor changes will be assessed on a case by case basis.

It generally takes 7-14 days to process and notify the Chief Investigator of the outcome of a request for a variation.

Major changes, depending upon the nature of your request, may require submission of a new application.

Audits:
All active ethical clearances are subject to random audit by the UHREC, which will include the review of the signed consent forms for participants, whether any modifications / variations to the project have been approved, and the data storage arrangements.
Appendix F: Approval Letter from the Royal University of Bhutan

RUB/DRER/MA/2010/169
25 July 2011

The Dean of Research
Queensland University of Technology
Brisbane, Australia.

LETTER OF CONSENT

Sir,

Mr. Sonam Rinchen, PhD Candidate, QUT, Australia, has written to the Royal University of Bhutan (RUB) seeking consent for him to conduct his doctoral research titled "How does the emotional climate of pre-service teachers' science classrooms at the Santse College of Education, Royal University of Bhutan respond to teaching-learning events?" in RUB. The Department of Research and External Linkages of the Royal University of Bhutan is pleased to grant him approval to conduct the proposed study, which sounds fascinating and of significance to teacher education in Bhutan. The department would like to wish him the very best in accomplishing his project goals.

Sincerely,

Dorji Thinley, PhD
Director of Research and External Linkages
Appendix G: Approval Letter from the Samtse College of Education

The Director
Samtse College of Education
Samtse, Bhutan

Subject: Permission to conduct study at Samtse College of Education

Date: 3.10.2011

Sir,

With due respect, I would like to draw your kind attention on the following lines for your information and kind consideration. I am a post graduate student in a PhD programme at the Queensland University of Technology in Brisbane, Australia. As a part of the programme I need to carry out a research study and submit a thesis.

My research is on A Study of the Emotional Climate of Science Classes for Pre-service Teachers in Bhutan. In particular, I am interested in exploring “How does the emotional climate of pre-service teachers’ science classrooms at the Samtse College of Education, Royal University of Bhutan respond to teaching-learning events?”

The following specific questions will be used to guide the study:

1. What emotional events are experienced by pre-service teachers in a SCE science classroom?
2. What patterns emerge from examining pre-service teachers’ perceptions of the emotional climate of the class?
3. What is the relationship between emotional climate and classroom events?
4. How do pre-service teachers respond to classroom interventions to improve the emotional climate of a science class?

This study requires the involvement of B. Ed I Sc ‘B’ pre-service teachers and Ms. Ugyen Pem, Lecturer at Samtse College of Education, Royal University of Bhutan, Samtse.

The study will commence in the first week of October, 2011 till end of May, 2012. The duration of the study will be for 5 months trying to understand the emotional patterns of the science classroom. During this period the proceedings of the science class will be videotaped followed by a cogenerative dialogue. A face to face interview lasting approximately one hour that will be audio recorded and some observations will be carried out.

The study will not hamper the activities of the college. The participants in the study will personally benefit by sharing and discussing their experiences, which will provide them with insight in promoting a positive emotional climate in the science classrooms.

In this regard, I will remain ever grateful to sir, if you could kindly consent to the participation of B. Ed I Sc ‘B’ pre-service teachers and their Lecturer in my study.

Thanking you in anticipation,

Yours faithfully,
Sonam Rinchen

P.S. Ensure that standard norms of practices are followed during the study.
## RESEARCH TEAM CONTACTS

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<tr>
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## STATEMENT OF CONSENT

By signing below, you are indicating that you:

1. Have read and understood the information document regarding this project.
2. Have had any questions answered to your satisfaction.
3. Understand that if you have any additional questions you can contact the research team.
4. Understand that you are free to withdraw from the study, without comment or penalty but this request will not be entertained once you have signed the consent form.
5. 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.
6. Understand that the project will include audio and video recording. Video images and audio recordings will not be done for those participants wishing not to participate. If your image is videotaped inadvertently, your image will not be used in the analysis or in case if it is used the images will be blurred or use sketches to conceal identity.
7. Understand that non-identifiable data collected in this project may be used as comparative data in future projects.
8. Agree to participate in the project.

Name: ........................................................
Signature:...................................................
Date: ........................................................

Please return this sheet to the investigator.
Appendix I: Consent of Participants for Image Release

PLEASE RETURN THIS COMPLETED FORM TO MR SONAM RINCHEN
A COPY WILL BE PROVIDED FOR YOUR RECORDS

If you agree to give consent regarding the use of your image in the release, please read and complete the consent below.

Consent

1. I agree to the University using, reproducing and disclosing photographic or video images of me as explained in this Image release: Research Participants Information Sheet and Consent Form.

2. I agree that I will make no claim against QUT for any payment or fee for appearing in promotional material or advertisements and release QUT from any other claims arising out of the University’s use of the images of me.

3. I understand that the anonymity afforded me as a participant in the research project “emotional climate of pre-service teachers science classroom” will not be revoked if I appear in this release.

Name: ........................................................
Signature:...................................................
Date: ........................................................

Please return this sheet to the investigator.
Appendix J: Glossary

**Bachelor of Education**
Bachelor of Education (B.Ed) is a four year degree for those aimed to join teaching profession in the government and non-governmental educational institutes. The minimum qualification required for entry into B.Ed is grade 12 (science), (Arts) or (Dzongkha). The students from science stream are trained to teach mathematics, physics, chemistry and biology. While students from arts stream are trained to teach subjects like history, geography and English, and students with Dzongkha background are trained to teach national language ‘Dzongkha’.

**Cogenerative dialogue**
Cogenerative dialogue is a conversation where audience/students collegially share experiences on what was successful and not so successful about classroom learning and open areas where participants can take collective responsibility to amend the shortcomings of teaching and learning from the subsequent classes (Tobin & Roth, 2006).

**Collective effervescence**
Collective effervescence (CE) is an energised reaction produced when audience experience something emotional together. For CE to result the audience must be mutually focused on a single idea or outcome. Secondly, they must be entrained into laughter through jokes, speech through inspiring talks, and rhythm through melodious voice to bind the participants. When both of these elements are present, the members in the group begin to change. A person’s individuality will slip away and start to embrace group’s ideology resulting into heightened emotions and members become more receptive to group ideas.

**Co-presence**
Bodily co-presence refers to people working or interacting in close physical proximity (Collins 1990, 2004).

**Coteaching**
Coteaching is an approach of distributing power and responsibility for teaching and learning between teachers and students. Coteaching is based on the fundamental idea that practices can be understood only from the perspective of the multiple participating subjects. It also enabled beginning teachers to learn by working in an activity at the elbows of the senior and experienced teachers (Roth & Tobin, 2002).
| **Druk** | Bhutan is also referred as ‘Druk’ meaning the land of the thunder dragon. |
| **Dzongkha** | Dzongkha is the national language of Bhutan. |
| **Emotional arousal** | Human beings experience emotions on an ongoing basis, we sometimes enter a state of arousal, in which our bodies experience heightened physiological activity and extremes of emotion. States of arousal can be positive and negative in experience, for example in excitement or fear. |
| **Emotional climate** | Emotional climate is a collective state of emotional arousal. A collective sense of joy and team spirit would lead to a positive emotional climate. Conversely, collective anger, sadness, and fear are associated with a negative emotional climate. |
| **Emotional energy** | Emotional energy is generated when there is a synchrony in body movements, facial expressions and vocalisations of participants involved in the interactions. For instance, a class that reciprocates to a group role play with laughter and applause exhibits positive emotional energy (Tobin, et al., 2013). |
| **Emotional entrainment** | Emotional entrainment is an excited reaction produced as a consequence of an action in an interaction. For instance, when a humoristic teacher has his students spellbound, he has entrained them into the humour. Similarly a charismatic teacher can have his students entrained to his lecture. |
| **Energy intensity** | Energy intensity is a measure of energy in the acoustic signal and it reflects the effort required to produce the speech. It is usually measured from the amplitude acoustic wave form. The standard unit used to quantify intensity is a logarithmic transform of the intensity called the decibel (dB) (Scherer, 1982). |
| **Five year plan** | Five year plan is Bhutan’s economic development plans to augment agricultural and industrial output within a period of five years. The first five year plan was launched in 1961 with a total outlay of Nu. 107.2 million (US $18,13600.00 approx.) |
| **Gaze** | It is the study of the movements and direction of the eyes in visual interactions. Kendon (1967) who was one of the first to study gaze explain several functions of gaze such as: monitoring (when actors are involved |
in interactions) and expressing ones feelings and attitudes during interactions (widened eyes indicate fear and tensed lower lids indicate anger [Ekman & Friesen, 1975]).

**Gross National Happiness**

Gross National Happiness (GNH) is the developmental philosophy of Bhutan promulgated by His Majesty the fourth King of Bhutan. Education is one of the nine domains of GNH.

**Ministry of Education**

Ministry of Education is headed by a minister closely supported by a secretary and two directors (school education and adult and higher education).

**Modern Education**

Bhutan remained in self-imposed isolation until the mid-twentieth century. Prior to the advent of modern education, most Bhutanese children underwent monastic education in the Buddhist monasteries. The transmission of knowledge, skills, and values were mostly done orally. Bhutan began her socio-economic developmental activities in a more organised manner only with the launch of the first Five Year Plans (FYP) in 1961. With the launching of first FYP any developmental activities in Bhutan was properly planned and mobilised to different sectors and regions (RGOB, 1999). Since then, any approach to development was considered as modern in Bhutan.

Hence, the education system offered from 1961 onwards has been branded as modern education within the purview of overall national development. It also appears that around that time science and other disciplines were introduced in the schools with English as the medium of instruction.

**Module**

Module consists of a set of learning opportunities, organised around a well-defined topic, containing: Specific Objectives, Teaching-Learning Activities, Subject Matter to be covered and Evaluation that uses criterion-referenced method (SCE, 2009).

**Mutual focus of attention**

Mutual focus of attention means that people attend to “the same activity, and [have] mutual awareness of each other’s attention” (Collins 1990, p. 31).

**Pitch**

Pitch ($F_0$) is the rate at which the vocal folds open and close across the glottis. Acoustically, pitch is defined as the lowest periodic cycle component of the acoustic wave form, and is extracted by computerised tracking algorithms (Scherer, 1982).
PRAAT

Praat is a free scientific computer software package (http://www.praat.org) for the analysis of the sound of human speech (phonetics). It was designed, by Paul Boersma and David Weenink of the University of Amsterdam. It can run on a wide range of operating systems, including various versions of Unix, GNU/Linux, Mac and Microsoft Windows (95, 98, 2000, XP, Vista). Praat means talk in Dutch word.

Pre-service teacher

In Bhutan pre-service teacher refers to grade 12 graduates enrolled in the colleges of education to undergo four years of B.Ed programs.

Proxemics

Proxemics is a study of how people perceive and use space to achieve communication goals. The physical distance between people indicates the type of relationship they have. Body alignment, physical contact and eye contact further reveal the acquaintance between people (Hall, 1963; Harrigan, 2005). For instance, negative emotions (i.e., hatred, apathy, and anxiety) are caused by an increase in personal distance between people whereas the gap decreases when a person is emotionally connected to other members.

Royal University of Bhutan

Royal University of Bhutan (RUB) was instituted in 2003 with ten federated member colleges spread across the country. Each college offer different programs.

Samtse

Samtse is one of the 20 districts in Bhutan. Samtse is the home for ‘Lhotsampas’ – people from south. It also housed Lhop or Doya people who practices unique social and religious beliefs. Case College of Education one of the two campuses of teacher training college of RUB is also located at Samtse.

Sanction

Sanctions refer to the feedback (e.g., words that are spoken or body language such as facial expression and gestures) from others in an interaction and the realisation of expectations and needs. Feedback and fulfilment of expectations can influence emotional arousal. When individuals perceive that others are supportive of what they are doing and saying, individuals will feel that they are being positively sanctioned (Turner, 2007). Lack of support from others may be perceived as a negative sanction.

Shared emotion

Shared emotion refers to the common mood rather than to dramatic emotions (Collins, 2004).
| **Synchrony** | Synchronisation is the simultaneous occurrence of events in a system. For instance, synchronisation of body actions, talk, gaze, laughter, etc. |
| **Speech rate** | It is the measure of the speed at which words or syllables (speech) are uttered per minute. It may include either complete utterances or only the voiced segments of speech (Scherer, 1982). |
| **Turning Point™** | Turning Point™ is software that allows one to communicate with audience/students interactively using hand-held keypad response units called keypads or clickers. It also creates detailed reports for analysis at the click of a mouse. In this study Turning Point™ enabled students to record their perceptions of the classroom EC at every three-minute interval. |