Doctoral Dissertation

Exploring Beliefs on Teaching-Learning and Actual Practices: A Case of Secondary School Science Teachers in Bangladesh

SIDDIQUEE MUHAMMAD NUR-E-ALAM

Graduate School for International Development and Cooperation
Hiroshima University

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SIDDIQUEE MUHAMMAD NUR-E-ALAM

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Committee on Final Examination:

Hideo Ikeda

IKEDA Hideo, Professor, Chairperson

BABA Takuya, Professor

Kinya Shimizu

SHIMIZU Kinya, Professor

T. Hayashi

TAKEHIRO Hayashi, Professor

Masakazu Kita

KITA Masakazu, Professor, Garduate School of Education, Okayama University

Date: July 30, 2014

Approved:

FUJIWARA Akimasa, Professor
Dean

Date: September 5, 2014

Graduate School for International Development and Cooperation
Hiroshima University

ABSTRACT

Poor quality of secondary science education is the most critical global concern. The poor quality education in the area of science in Bangladesh is attributed to low learning interest, low enrollment, and low achievement, generating gradual declines of science learners in general, as well as of the candidates of the national examinations (MoE, 2006). Those may be attributed to poor quality of teaching. A considerable body of research, alternatively, advocates that teachers' beliefs about teaching and learning affect their teaching practices and affect many aspects of their professional work. However, these beliefs and practices influence in many contextual and teacher's levels factors (Ernest, 1988). In recent times, researchers have interested in exploring teacher's beliefs in general, and science teachers' epistemology in particular. Since teachers' beliefs especially beliefs about teaching-learning, play a major role in every aspects of teaching-learning researchers advocate the need of closer examination for understanding the relationship between teacher beliefs and educational practices (Pajares, 1992, Richardson, 1996). However, very few studies have explored beliefs and practices closely with multiple data sources especially real lesson observation with video camera. Extensive review of literature reveals that there has been no research conducted yet to explore teacher's beliefs and practice in Bangladesh. Therefore, the present study was designed to explore science teachers' beliefs and their actual practices closely through fine grain analysis of their espoused and enacted beliefs with multiple data sources. It also investigates the relationship between beliefs and practices and attempts to identify the background factors that influence teachers' beliefs and practices in lesson implementation in the secondary schools of Bangladesh.

Multiple sources of data gathered from questionnaire survey, interviews, and lesson observation in camera and observation checklist. Two hundred and fifty three secondary science teachers were surveyed from co-education secondary schools at Dhaka city while 13 of them, selected through maximum variation technique, were interviewed. Among the survey and interview respondents 89 and 4 were female respectively. The age of the participants ranged between under 25 up to 60 years with teaching experiences ranged between one year to more than 20 years. They studied Physics (P), Chemistry (C) or Biology (B) at their graduation. All of them have Bachelor Degree in education (B.Ed.) and some of them received in-service trainings which include: Subject Based Cluster (SBC) training; Continuing Professional Development (CPD) training; Teaching Quality Improvement (TQI) training; and 3 months Overseas Training (OT). Fourteen science lessons of thirteen science teachers at secondary level (Grade-VI-X) were observed and recorded. The observed lessons covered a range of topics included in the science syllabus. The average duration of the lessons was 32 minutes and average size of the class was 42. The data was collected in February and March 2012 and in April 2013. Ipsative score was accounted for survey questionnaire while interview and video captured data were analyzed by using coded categories after transcribing verbatim. Miles and Huberman (1994) suggested method was used for analyzing interview data, while video data for classroom observation was analyzed through Flanders Interaction Analysis method and Questioning-based Discourse Analysis method suggested by Flanders (1970) and Chin (2006) respectively. Finally, the results from the analyses were thoroughly discussed and summarized accordingly.

The results about teachers' beliefs on teaching-learning aspects revealed that less than half of the secondary science teachers of the researched schools hold traditional beliefs regarding teaching-learning; more than one fifth of the participant teachers hold modern beliefs while

nearly one third of them hold transitional beliefs. Both modern and traditional science teachers were consistent in expressing their beliefs regarding teaching-learning. However, secondary science teachers under transitional group did not have holistic and consistent view about teaching-learning aspects. They possessed modern belief about teaching strategy and teachers′ role aspects of teaching-learning. On the other hand, they held traditional beliefs about students′ role, learning content and learning environment aspects. Since beliefs about teaching-learning are intertwined, in-service trainings and other professional trainings should address all the aspects of modern teaching-learning in a packaged programme so that the teachers can have a complete idea about modern approach of teaching.

The results regarding teaching practices unveiled that the science teachers of the researched secondary schools mainly employed didactic teaching (teacher-centered) where students′ participation in the process of learning was negligible. Evidently, teachers communicate student primarily through lecturing, ask many lower-order questions which triggered word or phrase type student′s response, correct student wrong response and praise correct response in a non-interactive, monologic discourse manner.

A reflection of beliefs was evident on teaching practices. It is found that teachers held modern beliefs regarding teaching-learning employ facilitative teaching practices. They use very few lecturing, allow student to talk, listen students′ ideas carefully, ask various type of questions, employ much more neutral feedback to students′ responses, and use several teaching method. On the other hand, teachers held traditional beliefs employ didactic teaching practices. They use predominant lecturing, hardly allow students to talk, criticize and justify authority, basically use lower order question to check student′s content knowledge; use evaluative feedback to students′ responses, and employ a handful teaching method. While transitional teachers play dual role in teaching practices.

The study also revealed that teaching experience and in-service training exert influence on teacher's beliefs and their teaching practices. Science teachers who had long teaching experience and received much more in-service trainings possessed modern beliefs. Similarly, those teachers employed more student-oriented practices.

The current teaching practices revealed through this study is completely opposite as stated in the teacher education curriculum of Bangladesh. It is found that the way secondary science teachers perform teaching practices was not able to involve learns into learning process while active involvement of the learners into the learning process is the core of science teaching depicted in the secondary teachers education curriculum. Therefore, this study recommends employing facilitative feedback to students' various responses in order to make prolong interaction results active involvement and meaningful learning towards scientifically literate citizen, 'the ultimate goal' of science education in Bangladesh.

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DEDICATION

DEDICATED

TO

MY BELOVED WIFE REZINA AHMED

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LIST OF ACRONYMS

B.Ed	Bachelor of Education
BANBEIS	Bangladesh Bureau of Educational Information and Statistics
BISE	Board of Intermediate and Secondary Education
CPD	Continuing Professional Development
DSHE	Directorate of Secondary and Higher Education
FIACS	Flanders Interaction Analysis Categories System
HSC	Higher Secondary School Certificate
LASI	Learning Assessment in SEQAEP Institutions
MoE	Ministry of Education
NCTB	National Curriculum and Textbook Board
NRC	National Research Council
NSA	National Student Assessment
OECD	Organization for Economic Co-operation and Development
OT	Overseas Training
SBC	Subject Based Cluster
SEQAEP	Secondary Education Quality and Access Enhancement Project
SSC	Secondary School Certificate
STE	Secondary Teacher Education
TQI-SEP	Teaching Quality Improvement in Secondary Education Project

CHAPTER 1

INTRODUCTION

1.1. Background of the study

Education in Bangladesh has three major stages-primary, secondary and higher education. Primary education is a 5-year cycle while secondary education is a 7 year one with three sub-stages: Junior Secondary Education (Grades VI-VIII), Secondary Education (IX-X) and Higher Secondary Education (Grades XI-XII). The entry age for primary is 6 years. The junior secondary, secondary and higher secondary stages are designed for age groups 1-13, 14-15 and 16-17 years. After finishing Grade X, students have to sit for a public examination and earn a Secondary School Certificate (SSC) degree and after finishing Grade XII, they earn a Higher Secondary Certificate (HSC) degree.

Higher secondary is followed by baccalaureate level education in general, technical, technology and medical streams requiring 5-6 years to obtain a Master's degree. In the general education stream, higher secondary is followed by college/university level education through the Pass/Honors Bachelor Degree course (3/4 years). Master degree courses are of one year for honours bachelor degree holders and 2 years for pass bachelor degree holders. Higher education in the technical area also starts after higher secondary level. Engineering, agriculture, business, medical and Information & Communication are the major technical and technological education areas. In each of the courses of study, except for medical education, students are required to complete a 4-year courses work; the case of medical education, a 5-year course of study is required for the first degree (BANBEIS, 2009). At junior secondary level student must study science known as "general science" as a compulsory subject. At this stage there is no stream like science, arts or business studies. Stream-wise segregation starts from grade nine. However, science is taught by the same teacher at Grade VI-X. Junior secondary and secondary science teachers are always together, while discipline-wise teachers are found from Grade XI-Grade XII.

There are several institutions for imparting education and training leading to the award of non-Baccalaureate certificates, as well as degree for teachers at different levels of the education system. There are 54 public sector Primary Training Institutes (PTIs), which offer 1-year Certificate in Education (C-in-Ed) course for the teachers at the primary schools. There are 14 public and 97 private sector Teacher Training Colleges (TTCs), offering 1-year Bachelor of Education (B.Ed.) courses and 1-year Master of Education (M.Ed.) courses for the teachers of secondary levels schools (BANBEIS, 2009). Bangladesh Open University (BOU) also offers B.Ed. course through distance education mode. The Institute of Education and Research (IER) of Dhaka University offers 4-year courses leading to Baccalaureate degree with honors in education, followed by 1-year Master of Education course, as well as post-graduate studies leading to M. Phil and Ph.D. in education. Higher Secondary Teachers Training Institutes (HSTTIs) conduct in-service trainings for both the secondary school and college teachers.

In Bangladesh, secondary education is one of the utmost sectors of education, which is under great focus now because of quality concerns. Although significant progress has been made in providing more young people with access to secondary education, declining quality in student performance remains a major anxiety (MoE, 2003). Like many other countries, in Bangladesh poor quality of science education is the most critical distress at secondary levels (Grades VI-X). The poor quality education in the area of science is attributed to low learning interest, low enrollment, and low achievement, generating gradual declines of science learners in general, as well as the candidates of the national examinations (MoE, 2004 & 2006). According to the demand of the time, students of the secondary levels are not reaching up to the mark in learning science, mother language, and English along with other necessary subjects (MoE, 2004). The number of science students in Bangladesh decreases at a greater rate. The decreasing rate is 31.6 percent in the last eight years (2001-2008). In the secondary level, in 1988, around 41.35 percent of the students studied science. According to the research, the percentage came down to 25.4 percent in 1995 and 23.76 percent in 2008 (DSHE).

The vulnerable condition of science education depicts also the shortage of laboratory, availability of the laboratory equipment, shortage of science teachers and trained science teachers in Bangladesh as reported by Directorate of Secondary and Higher Education (DSHE) and National Curriculum and Textbook Board (NCTB). The challenges for improving the quality of the education system, however, are significant, including low learning levels, inadequate acquisition of non-cognitive skills, inequitable learning among students, a high degree of variation between schools, low teacher motivation, low time on task, weak examinations and teacher development systems, limited incentives for performance compared to even more limited disincentives for poor performance, and low levels of accountability for the use of public finance (World Bank, 2013).

Education is one of the essential tools for national development. The level of socio-economic development in the country is strongly connected to education. It is generally accepted that the quality education leads to economic growth hence reduced poverty, improve health and generate creative citizens. Bangladesh is striving for quality education by advocating for quality teaching method that can make positive impact on learners through pre-service and in-service teacher education at all levels, to reach the ultimate goal of creating scientifically literate citizens. The national goal of science education in Bangladesh is to prepare the students in such way that they can earn international standard in expressing their talents, pursuit of knowledge and creativeness in a novel situation (MoE, 2009). In other word, government wants to create scientifically literate pupils.

In order to improve the quality of education in Bangladesh, high priority is given for capacity building of the secondary teachers through providing modern, international standard teacher education programs**.** To provide quality teacher education, in 2006, a competency based Secondary Teacher Education (STE) curriculum was made and implemented in 2006-2007 session. A paradigm shift regarding teaching and learning, i.e. teacher-centered to student-centered, is portrayed in the newly developed teacher education curriculum. The main changes of the new curriculum regarding teaching are as follows:

- Teaching is depicted as student-centered and specific problem focused
- Teachers creates learning environment and act as a facilitator
- Active involvement of the learners is the heart of the teaching. Learners must involve in the learning process through variety of learning experiences.

- Open investigation and field trip has been emphasized instead of recipe style laboratory work.

In order to familiarize with the new system of teaching and learning depicted in the curriculum, a country-wide teacher training named, Teaching Quality Improvement (TQI), was conducted. The main focus of the training includes: engaging learners into teaching learning process through variety of teaching experiences; presenting and reflecting group work; providing positive feedback (without hearting learners by using negative comments in the case of wrong or immature ideas), asking different types of question especially open and probing questions, teacher act as facilitator and the main responsibility of the teachers depicted as a supporter of student learning. Around 200,000 secondary teachers already received TQI training (TQI-SEP, 2009). In addition to that the country has undertaken the first credible assessment of learning, the National Student Assessment (NSA) in 2011, and the very first assessment of its kind in secondary education, the Learning Assessment in SEQAEP Institutions (LASI) in 2012. These are bold steps and provide sound bases for assessing the health of the education system (World Bank, 2013).

However, all these years conducting such interventions, there seem to be no considerable improvements in the practices of teachers in the real classrooms. The unsuccessful attempts could be attributed to lack of congruence between the intent of the programs' innovations and teacher's pedagogical knowledge, beliefs and practice. The innovations seem to have been introduced by authorities through top-down approaches, ignoring teachers' beliefs and practices. Many studies warn of the inherent problems associated with ignoring classroom teachers' beliefs about reform (Czerniak & Lumpe, 1996). If discrepancies between teachers beliefs and the ideas underpinning any these innovations are not identified, analyzed and addressed, such interventions may not be effective. Innovations programs that aim at shaping teachers classroom practices would therefore be effective if what had hinders improvements in teachers' classroom practices is identified and understood. This means that without understanding what happens in the classroom, support programs and efforts may not adequately prepare teachers to meet the challenges that teachers face in the classroom.

1.2. Rationale of the study

The teacher is the most important factor in the teaching learning process, since he/she is the medium of communication between the subject and the pupil. Therefore, the role of the teacher is increasingly getting attention (Osborne et al., 2003; National Research Council, 1996; AAAS, 1989; Bybee, 1993), not only because of fact that students' enjoyment of science subjects is highly affected by teacher behavior (Darby, 2005) but also teachers are viewed as key components in the current endeavors to reform science curricula (Tobin et al., 1994; Prawat, 1992). Ironically, however, they are also viewed as major impediments to change due to their traditional beliefs. According to Bandura (1986), an individual's decision throughout his life is strongly influenced by his beliefs.

Kuhn's (1970) model regarding changing paradigms in the concept of science teaching involves the belief that, in the scientific community, there are accepted examples of laws, theory, applications, and instrumentations. Kuhn's theory of paradigm shifts gives a rationale for changing teachers' beliefs and how these beliefs play a major role in teachers' willingness and ability to change their practices. A change in teachers' practice is brought about through change in their beliefs in learning and teaching. With a similar vein, Isenberg's (1990) research indicated that teaching and learning had shifted focus from observable teachers' behavior to teacher beliefs and their impact on teachers' behaviors. This research differs from earlier research that viewed teachers as technicians delivering a prepackaged curriculum. Researchers now acknowledge the powerful influence teacher's beliefs have on curriculum innovations (Cronin-Jones, 1991).

In recent times there has been a renewed interest in exploring teacher's beliefs in general, and science teachers' epistemology in particular. Previous researches asserted that the low achievements, low learning, low interest and poor performance in science are attributed to poor quality of teaching (Anamuah-Mensha, Asabere-Ameyaw & Mereku, 2004; Nelleke et al., 2010; Tsai 2002; OECD, 2009; Scheerens & Bosker, 1997; Osborne et al., 2003; NRC, 1996; Chacko, 1999; AAAS, 1990). A substantial body of research, alternatively, advocates that teachers' beliefs about teaching and learning affect their teaching practices and affect many aspects of their professional work (Vaiteka & Fernandez, 2010; Clark & Peterson, 1986; Nespor, 1987; Wolley et al., 2004; Nelleke et al., 2010; Markic & Eilks 2010; Prawat, 1992; Haney et al., 2003; Brousseau & Book, 1998; Jones & Carter, 2007; Pedersen & Liu, 2003; Fulton, 1999; Tsai, 2004; Levitt, 2002; OECD, 2009; Fang, 1996; Kagan, 1992; Thompson, 1992; Stipek et al., 2001; Pajares; 1992; Tobin et al., 1994; Keys & Bryan, 2001; Hawkey, 1996; Bandura, 1986; Beck & Lumpe, 1996; Rokeach, 1968; Haney et al., 1996; Haney & McArthur, 2002; Roehrig & Kruse, 2005; Louca et al., 2004). People beliefs are important influences on the ways they conceptualize tasks and learn from experience (Clark & Peterson, 1986). Bandura (1986) stated that beliefs represent the best indicator of why one person behaves acts, and makes decisions in a certain way. Kobella et al., (2000) concluded that beliefs influence all kind of interactions between teachers and pupils and also suggested that teachers' beliefs about teaching and learning always include aspects of beliefs exclusive to their chosen discipline or subject. Maor and Taylor (1995) concluded that, even in computerized classroom environments, teachers' epistemologies continue to perform an essential role in mediating the quality of student science learning. In their view, teachers' epistemologies are mainly concerned with pedagogical beliefs about teaching and learning (cited *in* Tsai, 2002). Nespor (1987) stated various belief systems and their role in teaching and learning especially non-consensuality, existence beliefs, and beliefs in alternative worlds, as well as how belief systems are very important determinants of how individuals organize the world into task environment and define tasks and problems (Nespor, 1987, p. 322). Pajares (1992) illustrates the notion that beliefs play a critical role in defining behavior and in organizing knowledge and information.

Every aspect of teaching is influenced by the multifaceted web of beliefs that teacher hold, including knowledge acquisition and interpretation, defining and selecting instructional tasks, interpreting course content, lesson planning and choice of assessment and evaluation (Keys & Bryan, 2001; Hewson & Hewson, 1988; Bryan & Atwater, 2002; NRC, 1996; Munby, 1982). It is asserted that teacher having strong belief system can minimize the influences of physical, environmental and situational constraints on classroom pedagogy (Hawkey, 1996; Benson, 1989). Teachers' beliefs are crucial to the success of any innovation in education (Wetzel, 2004). Any change in pedagogy can happen ***only*** with a corresponding change in teachers' beliefs (NRC, 1996 & Beck et al., 2000) because teachers' instructional practices are closely influenced by their curricular or pedagogical beliefs. With a similar vein, Minor and Pajares contended that teachers with traditional beliefs are more likely to employ didactic instructional practice, while those with modern (constructivist) beliefs are more likely to employ student-centered practice, i.e. facilitating learning. It is asserted that better understanding about teachers' beliefs, particularly beliefs on teaching-learning, is essential to improve teaching practices (Pajares, 1992; Richardson, 1996).

Teachers' beliefs and practices are important for understanding and improving educational processes (OECD, 2009). They are closely linked to teachers' strategies for coping with challenges in their daily professional life and to their general well-being, and they shape student learning environment and influence student motivation and achievement (2009, p.89).

Research has shown that these complex belief systems influence how teacher interact with students, the strategies they use for instructions, their classroom management systems, their selection of topics and subtopics, and their assessment practices (Jones & Carter, 2007). However, many factors influence teaching practices (Borko & Putnam, 1996). Teachers' subject matter knowledge, pedagogical knowledge, and pedagogical content knowledge all are essential factors that influence teaching practice, so too are the curriculum use, teachers' goals and social contextual factors. The complex nature of beliefs makes them hard to quantify (Pajares, 1992). Therefore, educational researchers call for closer examination and direct study of the relationship between teachers' beliefs and educational practices (Pajares, 1992).

As current Bangladeshi Secondary Teacher Education (STE) curriculum firmly stands on a student-centered stance of teaching and learning, it is therefore, urgent to investigate teachers' viewpoint of science teaching-learning to see if these viewpoint coincide with the intentions of the STE curriculum. This is because teachers' instructional practices are closely influenced by their curricular or pedagogical beliefs. Extensive review of literature reveals that no research has been conducted yet in Bangladesh regarding secondary science teachers' beliefs and practices. Due to the importance of beliefs and teaching practices in order to improve the quality of education, especially science education, researcher feels interested in exploring the science teachers' beliefs and their practices at secondary levels (Grades VI-X).

1.3. Research purpose

The present study was designed to explore Bangladeshi science teachers' beliefs regarding teaching-learning aspects and their actual practices through fine grain analysis with multiple data sources. It also investigates the relationship between beliefs and practices and attempts to identify the teachers' level background factors that influence beliefs and practices in lesson implementation in the secondary schools of Bangladesh. The study is guided by the following research questions.

1.4. Research Questions

1.4.1. Main research question

Are Bangladeshi secondary school science teacher's beliefs really reflected in their lesson implementation and what background factors do influence their beliefs and practices?

1.4.2. Specific research questions

a) What kind of beliefs do Bangladeshi secondary school science teachers hold regarding various aspects of teaching and learning?

b) What kind of practices do science teachers do in the actual classroom?

- bi) What type of interactions are present in the classroom?
- bii) What type of questions do teachers ask ?

biii) What type of students' responses are triggered?
biv) How does teacher react to students' various responses?
bv) What type of verbal discourse is present?
c) How do science teachers translate their beliefs into their teaching practices?
d) What background factors do influence teachers' beliefs and practices?

1.5. Overview of the methodology

The study mainly used purposive sampling to select science teachers for the survey, interview and lesson observation. Data was collected by adapting Teaching and Learning International Survey (TALIS) questionnaire- originally designed by OECD (2009) for capturing teachers' beliefs dimensions: Traditional and Modern (Constructivist)-, semi structured interview schedule, class observation by using videotaping and observation protocol. For the analysis, ipsative score was accounted for survey questionnaire, and interviews and video captured data were analyzed by using coded categories. Miles and Huberman (1994) suggested method for analyzing interview data was used, while video data for classroom observation was analyzed through Flanders Interaction Analysis method and Questioning-based Discourse Analysis method, suggested by Flanders (1970) and Chin (2006) respectively.

1.6. Originality and significance of the study

Research regarding teachers' beliefs and practices are still scarce in Asian countries. No research has explored yet beliefs and practice closely with multiple data sources especially real lesson observation with video camera. This study, therefore, is an initial effort regarding teachers' beliefs and practices especially in Bangladesh.

In most cases, research regarding teachers' beliefs on teaching-learning, divulges teachers' views on teaching strategy, teacher's role and student' role but no research has been reported yet regarding teachers' views on learning environment and learning content aspects of teaching-learning. Therefore, this study is a holistic one revealing the teachers' beliefs regarding all the basic aspects of teaching-learning.

Most of the researches regarding beliefs and practices have been conducted with student teachers and beginning teachers, research with in-service teachers in real classroom settings seems to be relatively thin (Savasci-Acikalin, 2009). Besides, most of the research with in-service teachers collected self-reported data through surveys regarding their practice without classroom observation (Beck et al., 2000; Hashweh, 1996; Haney et al., 1996; Hancock & Gallard, 2004) or with few observations (Haney & McArthur, 2002; Mellado, 1998). Therefore, this study will be helpful in terms of revealing some actuality about in-service science teachers' beliefs on teaching-learning, and how teachers' reflect their beliefs through teaching practices in real classroom context.

The results of the study are unique of its kind because it explains the relationship between beliefs and practices based on microanalysis of the lesson which include: the nature of teacher-student interaction, nature of teachers' questions, the nature of students' responses and the nature of teachers' feedback. So it will add new dimension in the world of research regarding beliefs and practices.

The findings of the present study will provide useful resources for improving science teachers' beliefs and teaching practices in Bangladesh and other developing countries with similar cultural background. Knowledge about beliefs regarding teaching-learning aspects and the knowledge about teaching practices will inform classroom teachers on how beliefs influence teaching practices.

The results of the study will also inform science teachers of Bangladesh about their current beliefs on teaching-learning and instructional practices. In order to bring any changes in education, teachers should know about their present status regarding teaching learning. Clear examples of the present teaching practice will give them chance to look into the matter about whether they are on the right track, as suggested by the secondary teacher education curriculum of Bangladesh. In-service and pre-service teachers will find the result as a typical operational model about traditional, transitional and modern science teachers' actual behavior in a real classroom context.

The policy makers, education advisors, curriculum implementers and other stakeholders in education will be informed about the components of teaching strategies especially questioning and feedback for effective teaching and learning of science.

The results of the study will inform teachers how to challenge student through facilitative feedback to develop conceptually and meaningfully. The results would be useful to change teachers' questioning pattern from lower-order to higher-order or conceptual-change types of questions. Results would be used as a feedback for modifying teachers' teaching behaviors in the classroom discussion.

Pre-service teachers may use the method of the study to investigate their own belief about teaching-learning and actual teaching practices to improve their own performance. Training developers will find the results useful in a sense to see how varieties of questions and feedback of the study involve learners into dialogical discussion.

1.7. Delimitation of the study

The study was delimited to select secondary schools in only one district out of 64 districts in Bangladesh. Interviews with teachers and lesson observations were delimited to only 3 schools in Dhaka city. The analysis of science teaching was delimited to teacher-student verbal interaction, while even the non-verbal powerful interactions were not considered as a part of teaching through this study.

1.8. Limitations of the study

The nature of the study did not allow the researcher to use probability sampling to cover all the regions in the country. Thus, the purposive sampling limits the generalizability of findings. A second limitation of this study is that in the analysis and interpretation of classroom discourse, the verbal data was used as a main marker of interaction, and therefore at best inferential. Barnes and Todd (1995) raised this methodological issue.

A third limitation relates to the generalizability of each respondent's utterance to the rest of the student. To a large extent of the data in this study were derived from discourse in whole-class setting. The analysis and interpretation of data were based on the utterances and responses of individual members who participated in the verbal exchanges, but collectively extended to the class as whole. According to Chin (2006) this generalization based on the assumption "whatever applied to the individual respondents also applied to the other students in the class" (p.1343). The assumption has limitations as the process of internalization do not simply involve direct transfer from social to personal planes and it is not possible to know for sure the extent to which individual students were able to internalize and make sense of the concepts addressed (ibid, 2006, p.1343).

A fourth limitation of this study is about the issue of using video. Data of the classroom teaching was collected through videotaping. One of the limitations of using video is that logistical constraints. According to Erikson (*cited in* Goldman, 2007) "we read the video streams quite differently when we are in the process analyzing them (ibid, p.14). Beccles (2012) raised this issue of logistical constraints of using video.

Finally, the issue about observer's effect. Despite care taken not to interrupt the lesson, one cannot rule out the influence about by the presence of the video camera in the class. It may have affected the natural behaviors of both the science teachers and the students. Barron (2000) raised the issue of video influence. In the same way, Roschelle (2000, p.719) reported that "the presence of the camera changing the event being observed".

1.9. Organization of the Dissertation

This dissertation consists of six chapters (Fig. 1.1) and the synopsis of each of the chapters is given below.

Chapter 1: Introduction

This chapter introduces the study. It contains the background of the study, rationales of the study, purpose of the study, research questions, significance of the study, overview of the methodology, limitations and delimitations of the study and the organization of the dissertation.

Chapter 2: Review of literature and theoretical framework

This chapter delves into the definition of beliefs, nature of teachers' beliefs, teachers beliefs about teaching and learning, relationship between beliefs and practices, role of socio-cultural context on forming beliefs, factors that influence beliefs and practices, source of teachers beliefs, the perspectives behind change in teachers' beliefs, and the previous research regarding beliefs and instructional practices. It also contains the teaching approaches, didactic teaching approach, facilitative teaching approach, Socratic teaching approach, literature regarding question and questioning, classification of teachers questions, use of teaches' question in inquiry, literature on feedback, the role of feedback in teaching and learning, classroom discourse and interaction and finally it includes the conceptual framework of the study.

Chapter 3: Methodology

The details of the research methodology as carried out are discussed here. It describes the research design, research tools, and participants of the study, data collection and data analysis procedure, and contains sections on validity measures of the study.

Chapter 4: Results

This chapter presents the results with an attempt to reply to all the research questions raised in this study. The chapter includes the results on teachers' beliefs on teaching-learning aspects, teaching practices, relationship between beliefs and practices and the factors that influence their beliefs and practices. The chapter is divided into three parts. The first part deals with teachers' beliefs in relation to teaching-learning and the factors that influence their beliefs. The second part shows the results of teaching practices and the factors that influence the teaching practices. The third part deals with the relationship between teachers' beliefs and their teaching practices.

Chapter 5: Discussion
This chapter discusses results on teachers' beliefs regarding teaching–learning aspects, teaching practices; relationship between beliefs and practices and the factors that influence beliefs and practices.

Chapter 6: Conclusions
This chapter presents the conclusions. In addition to that, implications of the study, recommendations, and the direction regarding future research also added in this chapter.

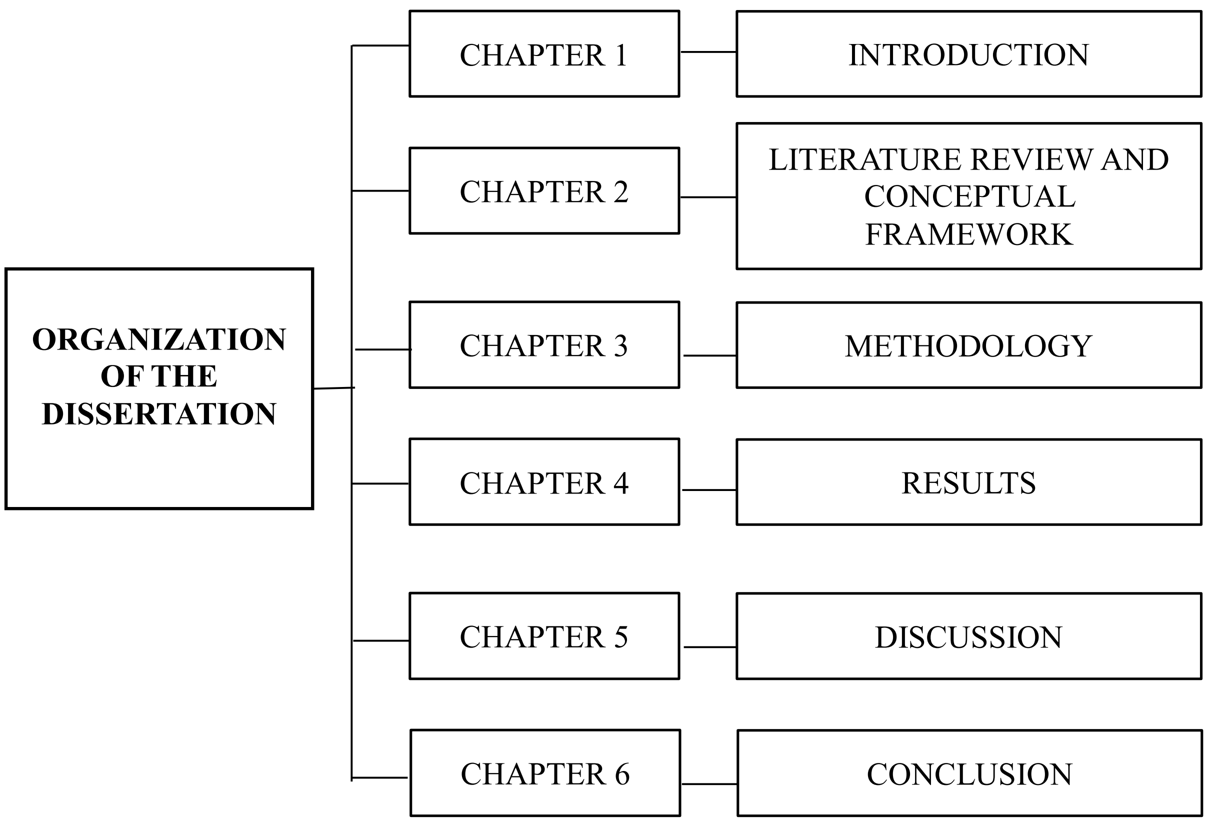

Figure1.1. Organization of the dissertation

CHAPTER 2

REVIEW OF LITERATURE AND CONCEPTUAL FRAMEWORK

2.1. Overview of the chapter

This chapter attempts to explore contemporary research literature on teachers' beliefs and practices. It includes the definition beliefs, nature of teachers beliefs regarding teaching and learning, the relationship between beliefs and practices, role of socio-cultural context on forming beliefs, factors that influence beliefs and practice, sources of teachers beliefs, previous research regarding beliefs and practice, various kind of teaching practices, questions and questioning, feedback, classroom discourse and interaction. Finally it includes one section about conceptual framework of this study.

2.2. Definition of Beliefs

Beliefs have been receiving a great deal of attention from educational researchers and widely discussed in the literature. Although there have been many studies related to beliefs, educational researchers still discuss the definition and the nature of beliefs. Therefore, there is a need to clarify the terms and definition of a belief in order to better understand the relationship between teacher beliefs and practice. In reviewing the research on this topic, Pajares (1992) refers to beliefs as a "messy construct", one that has not always been accorded much precision and which:

> …travels in disguise and often under a alias of attitude, values, judgments, axioms, opinions, ideology, perceptions, conceptions, conceptual systems, perceptions, dispositions, implicit theories, personal theories, internal mental process, action strategies, rules of practice, practical principles, perspectives, repertoires of understanding, and social strategy, to name but a few that can be found in the literature…(p.309).

According to Loucks-Horsely et al., (1998) "beliefs are more than opinions: they may be less than truth, but we are committed to them" (p.27). Pajares (1992) also note that the difficulty of in studying teachers' beliefs has been caused by definitional problems, poor conceptualization, and differing understandings of beliefs structures' (p.309). Researchers in other field have been noted that "beliefs" is not an easily define concept (Cantu, 2001). Abelson (1979) defined beliefs in terms of people manipulating knowledge for a particular purpose or under a necessary circumstance. According to Brown and Cooney (1982), beliefs are dispositions to actions and major determinants of behavior. Rokeach (1972) defined beliefs as "any simple proposition, conscious and unconscious, inferred from what a person says or does, capable of being preceded by phrase "I believe that" (p.113). Ackermann (1972) examined beliefs in four different categories as behavioral beliefs, unconscious beliefs, conscious beliefs, and rational beliefs. Behavioral beliefs are not distinguished simply because of fixed behavioral patterns that anyone holding a certain beliefs will exhibit. Rather unconscious beliefs long-standing beliefs that can influence behavior over a long period of time but resist recognition by the agent. Unlike behavioral beliefs, unconscious beliefs cannot be interpreted from behaviors. Behavioral beliefs, by contrast, will be thought of as non-conscious rather than unconscious. Conscious beliefs are any beliefs a person has explicitly formulated and is aware of. Rational beliefs are defined as a philosophical idealization of actual belief structures.

Anthropologists, social psychologists, and philosophers have agreed upon a commonly accepted definition of beliefs; "beliefs are thought of as psychologically held understanding, premises, or propositions about the world that are felt to be true" (Richardson, 1996, p.103). In educational settings, Haney et al., (2003) defined beliefs as "one's convictions, philosophy, tenets, or opinions about teaching and learning" (p.367). Table 2.1.Summarizes the definitions of beliefs available in the literatures. To understand thoroughly what is meant be 'belief' it is necessary to understand its nature, as is discussed in the following sections.

Table 2.1. Definitions of Belief

Definition	*Source*
"individuals' thoughts are equated with belief."	Southerland, Sinatra, & Mathews, 2001
"lay theories…images…metaphors, and webs"(p.254)	Bird, Anderson, Sullivan, & Swidler, 1993
"both evidential and nonevidential, static, emotionally-bound, organized into systems, and develop(ed) episodically"(P.55)	Gess-Newsome, 1999
"affective and subjective"(p.335)	Southerland, Sinatra, & Mathews, 2001
"deeply personal, stable, lie beyond individual control or knowledge, and are usually unaffected by persuasion."(p.786)	Haney & McArthur, 2002
"attitudes, judgments, axioms, opinions, ideology, perceptions, conceptions, conceptual systems, preconceptions, dispositions, implicit theories, explicit theories, personal theories, internal mental processes, action theories, rules of practice, practical principles, perspectives, repertories of understanding, and social strategy"(p.309)	Pajares, 1992
"personal constructs"(p.1) "propositions considered to be true by the individual… non-evidential as they are based on personal judgment and evaluation"(p.2)	Luft, Roehrig, Brooks, &Austin,2003
"espoused theories of action"(p.178)	Kane, Sandretto, & Heath, 2002
"person's understanding of himself and his environment"(p.131)	Fishbein & Ajzen, 1996
"psychologically held understandings, premises or propositions about the world that are felt to be true"(p.103)	Richardson,1996
"subjective, private opinion"(p.227)	Coburn, 2000

Source: Adopted Jones and Carter, 2007

According to the summary of the beliefs it can be said that beliefs in educational settings as one's views or opinions about teaching-learning and the determinants of one's action.

2.2.1. Nature of teachers 'beliefs

Depending on the theorist or researcher's point of view, there are different views about the concept of beliefs. Dewey (1938) developed a bipolar model within which there were two opposite dimensions: on the one pole, beliefs were characterized as traditional, and on the other as progressive. These two poles formed a uni-dimensional system since the concept of belief consisted of traditional and progressive components which were negatively related. Therefore, a person oriented at the traditional pole would be expected to disagree with progressive ideas and vice versa (Mansour, 2009). Dewey's definition oversimplifies the concept of beliefs and lead to unrealistic understanding of its basic elements (Bunting, 1984). However, a multi-dimensional system has been tried by the researchers to identify the concept of beliefs since the 1970s. Referring to the work of Wehling and Charter (1969) shows that the concept of beliefs is identified as consisting of eight dimensions. Two dimensions describe subject matter and human adjustment matters, while other six describe instrumental and impersonal processes affecting educational outcomes.

Rokeach (1968), on the other hand, groups beliefs into five categories according to their connection with the central beliefs, and maintains that everybody has beliefs that belong to these five types. Type "A" formed earlier, involves the nature of oneself and one's physical and social world. Beliefs of this type are central. Owing to their connection with social norms, they are not prone to controversy and thus are hardly changeable. Type "B" beliefs differ from type "A", being private matters and independent of any social judgment. Type "C" beliefs share some characteristics with type "A" beliefs which, to a certain extent, are reshaped through an individual's derive from reliable secondary sources such as books and the media. The type "E" beliefs consist of beliefs about taste, which is personal and not to be interfered with. These beliefs are far from the central belief, and rarely connected with other types. They are not changed and are considered insignificant.

In an attempt to clarify the meaning of "beliefs", Pajares (1992) expresses the need to distinguish between beliefs and knowledge and explains that knowledge is based on objective fact, while beliefs are based on evaluation and judgment. Additional to this, Kagan (1992) argues that most of a teacher's professional knowledge can be regarded as belief, claiming that knowledge is considered a belief that has been affirmed as true on the basis of objective proof or consensus of opinion.

According to Mansour (2009), a further distinction between beliefs and knowledge is that while knowledge often changes, beliefs are "static". In addition, whereas knowledge can be evaluated or judged, such is not the case with beliefs since there is usually a lack of consensus about how they are to be evaluated. Furthermore, there do not appear to be any clear rules for determining the relevance of beliefs to real world events. While there are doubtless other distinctions that could be made between the two, and by considering beliefs as a form of knowledge. This form of knowledge could be referred to as personal knowledge (Nespor, 1987). Kagan (1992) refers to beliefs as a "particular provocative form of personal knowledge" and argues that most of a teacher's professional knowledge can be regarded more accurately as beliefs.

According to Kagan, as a teacher's experience in classrooms grows, this knowledge grows richer and more coherent and thus forms a highly personalized pedagogy or beliefs system that actually controls teacher's perception, judgment, and behavior. Although teachers may have similar scientific knowledge, they are likely to teach in different ways because teachers' beliefs are more powerful than their knowledge in influencing the way in which they teach (Nespor, 1987). The discussion about the relationship among knowledge, beliefs, and practices indicate a clear disagreement whether knowledge control beliefs or beliefs control knowledge. In order to answer this disagreement, Mansour (2008a) carried out an empirical research and found that there is an interactive relationship between knowledge and beliefs. He asserts that the settled or developed teachers' beliefs act as an information organizer and priority categorizer, and in turn control the way it could be used. He added that in the interactions between knowledge and beliefs, beliefs control the gaining of knowledge and knowledge influenced beliefs. Having discussed the nature of beliefs, now it is necessary to focus on teachers' beliefs regarding science teaching-learning, as is done in the following section.

2.2.2. Teacher's beliefs about teaching and learning

In educational research, researchers often categorize teacher beliefs as either behaviorist (transmissionist) or constructivist beliefs (Fulton, 1999; OECD, 2009; Wolley et al., 2004; Tsai, 2002; Markic & Eilki, 2010, Mansour, 2009). These two beliefs dimensions are variously termed as direct transmission vs. indirect transmission; conventional vs. contemporary; teacher-centered vs. student-centered; constructivist vs. behaviorist; mechanical vs. dynamic approach of teaching and learning (Siddiquee & Ikeda, 2013, Wolley et al., 2004, Mansour, 2009). However, this dichotomy while useful in terms of being able to clearly categorize beliefs may be simplistic and misleading. As Ernest (1994) argues that theories of learning such as constructivism are so diverse that it is questionable whether we can possible categorize sets of beliefs in terms of a behaviorist or constructivist dichotomy.

Calderhead (1996) summarized teachers' beliefs related to teaching and learning into two categories by arguing that some teachers view teaching as a process of knowledge transmission, while other view it as process of guiding children's learning or as a process of developing social relationships. He also distinguishes between teachers' beliefs based on their experiences. Pre-service teachers start with control-oriented beliefs systems that emphasize the importance of maintaining order and good discipline, and guide the activities of the children. During training, these attitudes become more liberal and child-centered. However, when teachers enter full-time teaching, they revert to a control-oriented beliefs system.

Bell and Gilbert (1996) outline two extreme positions concerning the nature of teaching that can take place in a given classroom. They first states that the predominate belief is that the role of a teacher, as an expert in this knowledge, is to present such knowledge directly to students in a logical sequence. The second position is based on the beliefs that knowledge is constructed by individual (idea of constructivist), and that the role of the teacher is to be a facilitator who allows students to reconstruct, extend or replace their existing knowledge.

A diversified set of beliefs regarding teaching and learning are reported in various literatures (Samuelowicz & Bain, 2001). However, by considering the teaching-learning aspects-, teaching strategies, learning content, teachers and students roles and learning environment- most educators differentiate teaching beliefs into traditional and constructivist dimensions (Fulton, 1999; OECD, 2009; Wolley et al., 2004; Levitt, 2002). Key differences between the two beliefs dimensions regarding teaching-learning including teaching strategies, teachers and students roles, learning environments, students interactions and learning contents (curriculum), each of which is discussed in the following paragraphs.

Teaching strategies. The traditional teacher-centered classroom is a central elements of transmission based on behaviorist approach to teaching and learning. The transmission metaphor views the teacher as a principle source and the students as receivers of knowledge. These beliefs were supported by three dimensions: an objectivist view of knowledge (M. Johnson, 1987), a mental model for teaching and learning that is characterized by memorization , and the conviction that the teacher should have power over the student in most classroom situation (Tobin, 2000). In this classroom teachers were given more emphasis. It is the teacher who dominates the whole class and act as an authority (Griffin, 2006). Sometimes the teacher represents himself as the absolute knowledge purveyor that he delivers to the learners. The focus of such teaching is on disseminating pre-defining knowledge whose truth is legitimated through texts written by established authors with authority to 'know' (Preece & Griffin, 2006). Psychologists working within this paradigm are interested in the effect of reinforcement, practice, and external motivation on a network of associations and learned behaviors (Fosnot, 1996). Educator using such a behaviorist frame work preplan a curriculum by breaking a content area (usually seen as a finite body of predetermined knowledge) into assumed component parts- "skill"- and then sequencing these parts into a hierarchy ranging from simple to more complex. In stark contrast to behaviorism, radical constructivism allows and encourages the construction of models for cognition or mental process (Goldin, 2000). This social learning theory perhaps the most current psychology of learning undergirds much of the curricular and instructional decision making occur in education. Based on the work of Jean Piaget and Lev Vygotsky, among others, it is having major implications for the goals teachers set for the learners with whom they work, the instructional strategies teachers employ in working toward these goals, and the method of assessment used by school personnel to document genuine learning (Fosnot, 1996). In this view of learning, all knowledge is constructed by necessity from the knower's world of experience, and the "real world" is regarded as existing but in principle, unknowable (von Glasersfeld, 1991b cited in Goldin, 2000). Contemporary theory of learning has a dozen brands (Geelan, 1997a, cited in Dawkins, 2004), each of which emphasizes a different aspect of learning, most agree that it involves a dramatic change in the focus of teaching, putting the students' own efforts to understand at the center of the educational enterprise (Prawat, 1992). There are two principles in modern learning theory that would likely be found in every one:

- Students construct their own understandings
- The new understandings that student construct rest on the foundations of knowledge and understandings that they already exist (Dawkins, 2004, p.107)

The role of the teacher. In traditional teacher-directed teaching, the teacher sets learning objectives, and then plans to set activities designed to help learners meet those objectives (Pedersen & Liu, 2003) in a clear and precise manner. Because learners are not assumed to be able to determine a process to meet those objectives, it is the responsibility of the teacher to direct students through a step-by–step process and to make sure that any difficulties they encounter during this process are resolved (ibid). Content coverage is one of the teachers' highest priorities. In modern student-centered teaching, in contrast, the teacher presents the central questions, for example, issue, case, problem, and then work as facilitator as students determine the nature of response they will develop, and then formulate and carry a process to develop that response (Pedersen & Liu, 2003). As a mediator, the teacher must ensure that students are given opportunities for quality learning experiences to provide a solid base for learning with understanding (Tobin et al, 1994). Teachers help students to work through the difficulties they encounter by questioning them and helping them to identify alternative paths or resources, but they do not resolves these difficulties for the student (ibid). Thus, in all modern teaching-learning scenarios, the traditional telling-listing relationship between teacher and student is replaced by one that is more complex and interactive (Prawat, 1992). Once these parameters are established, the teachers needs to listen carefully to students' interpretation of data, paying particular attention to any individual's conundrums, puzzlements, confusions. And the teachers equally needs to pay attention to differences of opinion within the class, giving equal respect to each one, for as long as any student still takes it seriously. By focusing on puzzlements and contradictions, the teachers establishes the notion that ideas are complicated and worthy of time and consideration and that each student is capable of formulating interesting ideas. Further, the teacher acknowledges that "not knowing" is a state that is important to live with-the state that most of us are in most of the time (Fosnot, 1996, p. 71).

The role the student. In traditional teacher-directed instruction students work to meet the objectives set by the teachers (Pedersen & Liu, 2003). It is assumed that observations, listening to explanations from teachers who communicate clearly, or engaging in experiences, activities, or practice sessions with feedback will result in learning and that proficient skills will quantify to produce the whole or more encompassing concept (Bloom, 1956; Gagne, 1965, cited in Fosnot, 1996, p. 9). Further, learners are viewed as passive and they are simply tested to see where he or she falls on the curriculum continuum and then expected to progress in a continuous, quantitative fashion as long as clear communication and appropriate reinforcement are provided (Fosnot, 1996, p. 9). In contrast, student-centered learning, student work to provide a response to a central questions. Since students most sort out for themselves what they need to do and know in order to develop this response, student-centered approaches are more likely to promote student ownership over their process and learning (Pedersen & Liu, 2003) in a complex context of the classroom. Fosnot (1996), draw an image of such a more complex and interactive teaching- learning scenarios. According to her, perhaps first and foremost, the phenomenon students are asked to think about needs to be interesting, worthy of engaging their time and attention. In addition, it should offer a variety of avenues for exploration various routes of approach. Such a type educational enterprise, students are encouraged to express feeling related to their work (their frustrations as well as their interests), and to considered the entirety of the learning process within a playful learning environment. Traditional teacher-directed approaches often depend, at least in part, on extrinsic motivators, such as grades, degrees, or other rewards, to motivate students' efforts to learn while in student-centered approaches, teachers attempt to present a question that is interesting enough to motivate students to take ownership of the process of developing a response (Pedersen & Liu, 2003). As a result, student actions are driven by the goals they have set for themselves rather than external rewards promised by a teacher or institution (ibid). Increasing the amount of interaction between students during teacher-directed instruction was asserted in order to success in cooperative learning (National Center for Educational Statistics, 1999). This instruction, however, is frequently under teacher control, with teachers determining group membership, the nature of the interaction between the members, and even the role each member of the group plays (Pedersen & Liu, 2003). Teachers intervene in the group process when there are difficulties, and hold the group accountable for individual learning. Bruffee (1995) argued that the structure and vigilance teachers provide during cooperative learning tends to undermine students' control over their own process. Instead, modern approaches of teaching, which also assume a great deal of student interaction, are more keeping with collaborative learning than cooperative learning (Pedersen & Liu, 2003). Collaborative learning emphasizes students' self-governance of their interaction, allowing them to make decisions about with whom they work, and how (ibid). As student negotiates their relationships with each other, they must articulate their ideas, and engage in a disciplined social process of inquiry (Bruffee, 1995).

Learning content (Curriculum). Two curricula views are available in literature: popular view and dynamic view. Prawat (1992) stated that the popular view of curriculum (correspond to traditional view of curriculum) as fixed agenda, a daily course to be run that consists of preset means (i.e., a certain material to cover) and predetermined ends (i.e., a discrete set of skill or competencies). As for the 'transmission view' of learning, the curriculum is seen as the list of thing to be taught (Mansour, 2009). Science is thus presented as catalogue of facts. In contrast, modern view of curriculum, correspond to constructivist ideas, favor a more interactive and dynamic approach to curriculum, believing that it should be viewed more as a matrix of ideas to be explored over a period time than as road map. One would enter this matrix at various points depending on where students are in their current understanding (ibid). This view of curriculum is relaxed and flexible in nature and focusing on thinking and understanding by problem solving or inquiry rather than to cover the fixed content.

Learning environment. In traditional teacher-directed instruction, treating all students alike and responding to the group as a whole (NRC, 1996). Thus, the teacher focuses on whole class instruction without paying attention to students' puzzlement and naïve conception in a quite classroom context. In contrast, understanding and responding to individual student's interests, strengths, experiences, and needs were asserted in modern student-centered instruction (NRC, 1996). Teachers in this modern and dynamic learning environment offer a variety of avenues for exploration various routes of approaches (Fosnot, 1996) and where unexpected classroom happening is anticipated by the teachers. In an experiential study Weimer (2002) depicted very clear picture about student-centered learning environment:

> …My classes are louder and sometimes chaotic. People work in groups, others mill about, and sometimes a pair works something out on the board… (p.31).

On the basis of discussion a summary of modern and traditional teaching aspects are given in the table 2. 2.

Table 2.2. Description of Traditional vs. Modern teaching

Teaching aspects	Traditional belief	Modern belief
Teaching strategy	Teacher-centered, teacher lectures, clearly communicating predetermined knowledge	Student-centered, student set their own goal, determine resources, and activities that will help them meet those goals, group learning, hands-on activities, practical work, investigation
Teacher role	Dispense accurate knowledge; set learning goal, and check student knowledge by searching predetermined response. This is teacher who will determine what to teach and how to teach as an authoritarian	Facilitator, help student to develop their own inquiry, listen carefully to students' interpretation of data, paying particular attention to any individual's conundrums, puzzlements, confusions. Student ideas (correct or incorrect) are always respected
Student role	Passive role, teacher directed, recipient of information, listening to explanation from teachers, taking notes, raising questions only occasion, learning until mastery	Active role, creator of knowledge as an autonomous explorer. Self-directed learning
Learning content (Curriculum)	Popular view, planed and well sequenced structured curriculum, a finite body of predetermined knowledge; fixed and rigid in nature	More interactive and dynamic curriculum like as matrix. Relaxed and flexible. Focusing on thinking and understanding by problem solving or inquiry
Learning environment	Whole class instruction, routine activities, more formal, calm and quite in nature	Offer a variety of avenues for exploration various routes of approach. More casual, many things happening; small or peer group

2.2.3. Relationship between beliefs and practices

In reviewing research literature about teaching and learning, it is noticed that the relationship between teachers' beliefs and their practices was open to debate. A number of studies investigating the relationship between teachers' beliefs and practices have found that teacher beliefs are consistent with classroom practices. Through their work with the theory of planned behavior, Haney, Czernaik, and Lumpe (1996) determined that teacher beliefs are significant indicators of the behaviors that will be presented in the classroom. Teachers' beliefs about subject matter have also been found to influence day-to-day decisions about what to teach, what to skip, and how much class time to devote to particular topic (Cronin, 1991).

Hashweh (1996) conducted a study with 35 Palestinian science teachers in order to identify the relationship between their epistemological beliefs and classroom practices. Data obtained through the use of a three-part questionnaire consisted of critical incidents, direct questions about teacher strategies for conceptual change, and ratings of the use of and importance of specific teaching strategies. The author characterized teachers as learning constructivists, learning empiricist, knowledge constructivists, and or knowledge empiricist. He found that difference in epistemological beliefs influenced classroom teaching. According to the findings of his study, teachers holding learning constructivist beliefs are more likely to detect student alternatives conception, have a richer repertoire of teaching strategies, use potentially more effective teaching strategies for inducing student conceptual change and report more frequent use of effective teaching strategies compared with teacher having empiricist beliefs. The weakness of his study was that he collected self-reported data from teachers about their classroom practice without observation.

Haney and McArthur (2002) constructed case studies for four prospective science teachers in order to identify teachers' constructivist beliefs and classroom practices. Participants were purposively selected as a result of their scores on the Classroom Learning Environment Survey ([CLES] Taylor, et al., 1994). The CLES instrument has five subcategories that were viewed as critical to the formation of a constructivist classroom environment: (1) personal relevance, (2) scientific uncertainty, (3) critical voice, (4) shared control, and (5) student negotiation. Other data source came from classroom assignment, semi-structured interviews conducted after observation and classroom observations. The authors found that prospective science teachers' beliefs were in line with their practices. However, each participant was only observed teaching a self- selected constructivist lesson. As a result, the author may not find much inconsistency between teachers' beliefs and practices.

Pajares (1992) also cites several sources in support of the assumption that "beliefs are the best indictors of the decisions individual make throughout their lives" (p.307). He sums up research on teachers' beliefs by suggesting "a strong relationship between teachers' educational beliefs and their planning, instructional decisions, and classroom practices" (p.326) and adds that "educational beliefs of pre-service teachers play a pivotal role in their acquisition and interpretation of knowledge and subsequent teaching behavior" (p.328). In his view, beliefs are "far more influential than knowledge in determining how individuals organize and define tasks and problems and are stronger predictors of behavior" (p.311). However, there is still much debate as to whether beliefs influence actions or actions influence beliefs. For example, Pajares (1992) supports the notion that beliefs of teachers influence their perceptions, which in turn affects their behaviors in the classroom. In short, people act upon what they believe (Mansour, 2009). Similarly, Ajzen (1985) suggested that beliefs develop a person's value system that guides life's' behaviors. Ernest (1988) also argues that in mathematics, teachers' beliefs have a powerful impact on the practices of teaching during their transformation into practice. In the same vein, Clark and Peterson (1986) described teachers' beliefs and theories as "the rich store of knowledge that teachers have that affects their planning and their interactive thoughts and decisions" (p.258).

Although much research has indicated that teachers' classroom practice is influenced by their beliefs, there is still need to examine teachers' beliefs in order to clarify how they affect their practices. According to Mansour (2009), beliefs become personal pedagogies or theories to guide teachers' practices: teachers' beliefs play a major role in defining teaching tasks, and organizing the knowledge and information relevant to those tasks. However, some researchers have noted that reflecting on practice can change beliefs, for example, Luft (1999) conducted a study that captured teachers' changing beliefs about problem-solving during an in-service programme. Multiple tools used for data collection. Results indicates that the relationship between believes and practice is interactive: (a) implicit beliefs became explicit after collaboration and reflection; (b) beliefs and practices were allowed to interact and align; and (c) as the teachers became more aware of their beliefs, they were more inclined to implement the practice in their classroom.

Shulman (1986) on the other hand, argued that change in beliefs preceded change in practice. Poulson et al., (2001) pointed out that the relationship between teachers' beliefs and practices is complex and explain that it is "dialectical" rather "unilateral"; therefore practice does not always come after beliefs, but may sometimes precede them.

Brickhouse, Bonder, and Neie (1987) found that one teacher who believed that "quantification differentiates science from non-science" (p.44) placed "a great deal of emphasis on quantification" (p.37) in instruction. Another teacher believed that "science is discovered" and used this as a rational for discovery labs, "which give the students an opportunity to be discoverers" (p. 44). However, other research conducted by Simmons et al., (1999) and Galton and Simon (1980) showed an inconsistency between teacher beliefs and classroom practices. For example, Galton and Simon (1980) indicated that the relationship between teachers' beliefs and their practices was not very strong. As Fang (1996) suggested, there may be inconsistencies between teachers' beliefs and practices due to the complexities of classroom context, which may constraint teachers' abilities to follow their beliefs and provide instruction that aligned with theoretical beliefs. Teachers' theoretical beliefs could be situational and manifested in instructional practices only in relation to the complexities of the classroom.

To sum up, the relationship between teachers' beliefs and practices are far from straightforward (Mansour, 2009). Beliefs can (a) be contradictory, and compete for priority; (b) have indirect but strong effects on teaching practices, and (c) be often context-dependent, so that they have differing strengths in differing context. The following section explains the role of the social context in forming and reforming teachers' beliefs and practices.

2.2.4. The role of socio-cultural context on forming beliefs and practices

A growing body research argues that teachers' beliefs should be studied within a framework that is aware of the influence of culture. Other studies argues that teachers' beliefs and practices cannot be examined out of context (Mansour, 2008b), but are always situated in a physical setting in which constraints, opportunities, or external influences may derive from sources at various levels, such as the individual classroom, the school, the principal, the community, or curriculum. Olson (1988) stated that "what teaches tell us about their practice is, most fundamentally, a reflection of their culture and cannot be properly understood without reference to that culture" (p. 69). Culture is a screen through which people view their lives and interpret the world around them.

Lederman (1992) suggests that the transposition of teachers' beliefs into classroom practices is mediated by a complex set of situational variables. Ajzen (2002) suggests that there are many elements that cause a mismatch between beliefs and practices. Real-life factors, such a learner behaviors, time, resources, and course contents, have an impact on the degree of beliefs-practice consistency. Ernest (1988) suggested two reasons why teachers' beliefs did not always match their practices. First there was the powerful influence of the social context that resulted from expectations of others, including students, parents, peers (fellow teachers), and superiors. It also resulted from the institutionalized curriculum: the adopted text or curricular scheme, the system of assessment, and the overall national system of schooling. These sources led the teacher to internalize a powerful set of constraints affecting the enactment of the models of teaching and learning mathematics. The socialization effect of the context is so powerful that despite having differing beliefs about mathematics and its teaching, teachers in the same school were often observed to adopt similar classroom practices. Secondly, there was the teacher's level of consciousness of his or her own beliefs, and the extent to which he or she reflected on his or her practice of teaching mathematics.

According to Mansour (2009) teachers' beliefs are knowledge, experience, and environment-based. Teachers are pragmatic, and may establish or validate their beliefs in context-specific environments where their instructional experience is successful. Nespor (1987) explains how the context plays the main role in forming teachers' beliefs: "the contexts and environments within which teachers works, and many of the problems they encounter, are ill-defined and deeply entangled…beliefs are peculiarly suited for making sense of such context" (p.324). According to Nespor, the contexts and environments of teachers' work make beliefs especially potent for defining tasks and organizing the relevant knowledge. Most of the research indicates that educational beliefs in general and teachers' beliefs in particular are not context-free (Fang, 1996; Pajares, 1992). It is therefore necessary to take into account the contextual factors that have shaped and formed certain beliefs. In the same respect, Mansour (2009) asserted that teacher' beliefs and the context in which their beliefs are developed and used should be taken into consideration in order to have a better understanding of how teaching and learning occur in classrooms and can be thus be enhanced.

Reading, analyzing and interpreting of the relevant research with teaching contexts, Cornbleth (2001) produced five "climate" or contexts of constraints that he characterized as: (1) a bureaucratic climate with an administrative emphasis on law and order; (2) a conservative climate intent on maintaining the status-quo; (3) a threatening climate of external curriculum challenges and self-censorship; (4) a climate of perceived pupil pathologies and pedagogical pessimism; (5) a competitive climate dominated by student testing and public school ranking. From Cornbleth's point of view, constraints on teachers and teaching are not merely singular or individual as in a single factor affecting an individual teacher. Rather, to understand constraints to meaningful teaching and learning, attention is directed to recurring patterns of contextual constraints that he called climates (Mansour, 2009) and to how these climates are collectively and interactively created to produce thinking that incorporates diverse perspectives and students.

2.2.5. Factors that influence the beliefs and the practices

It is argued in many researches that a complete understanding of the process of teaching and learning is not possible without a full understanding of the constraints and opportunities that impact upon the teaching and learning process (Mansour, 2008b). Researchers have attempted to explain the mismatching between teachers' beliefs and practices through the external and internal constraints pressuring the teacher (Abell, 1990; Abell & Roth, 1992).

Researchers in different fields define common external "stressors" that affect teachers' performance. These include: work overload, time restraints, and problems with child behavior, working conditions, relationship with colleagues, lack of resources, and the physical demands of teaching (Borg, Riding, & Falzon, 1991). Kelly and Berthelsen (1995) identified sources of constraints for teaching practices such as; time pressures, children's needs, non-teaching tasks, personal needs, parents' expectations and interpersonal relationship. Blasé (1986) carried out a qualitative study with elementary, middle, and high school teachers, emphasized that time was one of the most important constraints and that it could not be understood as independent of the other constraints that were perceived as directly interfering with the instructional time of teachers. To counteract the time constraints, lecturing and rote memorization were stressed as the main instructional method.

Okebukola and Jegede (1992) identified five clusters of factors inhibiting the effectiveness of science teaching by placing stress on the teachers. These includes student characteristics, such as "poor attitude of students to science lesson"; teacher characteristics, such as "having to teach a science subject for which one is not trained"; school environment characteristics, such as "difficulty of obtaining science teaching equipment", and condition of service, such as "lack of opportunities for professional improvement". The findings also revealed that the difficulty of obtaining science teaching equipment was the most stressful factor, especially given the experimental nature of the science subject. "The necessity of coping with teaching difficult topics" ranked second on the list of top stress factors, while "difficulty in completing the syllabus in the time available" ranked third. The other two involved "the necessity of coping with the demands of new curricula" and "the obligation to teach large classes".

OECD (2009) identify gender influence on teacher's belief and practices. It suggests that beliefs and practices of female and male teachers may systematically differ. Female teachers are likely than male teachers to see teaching as the direct transmission of knowledge and are most likely to adopt structuring and student oriented practices as well as cooperate more with colleagues. Teachers who undertake professional development (in-service training) undertake a wider array of teaching practices and are more likely to co-operate with other teachers (ibid, 2009).

Goelz (2004) mentioned end-of-course tests as a stress factor facing teachers. Such testes force many teachers to maintain a strict schedule that does not allow for creative teaching methods requiring student-generated learning, reflection, and discussion. With a similar vein, Muskin (1990) also pointed out that because teachers have to complete all the material required for the tests, they feel obliged to spend very little time on activities that promote constructivist-styled learning. This causes new teachers, who would otherwise like to focus on student-centered learning, to revert to the lecture style that many teachers hesitate to practice but often do.

The effects of gender on epistemological beliefs as revealed by Belenky et al.'s (1986) study were manifested in the forms of separate/objective knowing and connected/emphatic knowing, both of which belong to procedural knowledge. Using Belenky et al.'s framework, Schommer-Aikins and Easter (2006) recently reported a case where men scored significantly higher in separate knowing. Buehl et al., (2002) explored the domain-specificity of students' beliefs about academic knowledge by using a domain-specific beliefs questionnaire about mathematics and history. They found significance differences in students' beliefs about the effort required to gain knowledge in mathematics and history. Additionally, students believed that knowledge in mathematics was more integrated with other domains than history. This suggested that subject-matter domains may have exerted an influence on one's epistemological outlooks.

Maxion (1996) argues that teachers' beliefs are an integral part of classroom practices. When influencing factors (external and internal) complement teachers' beliefs, classroom practice and beliefs are compatible. When these factors interfere with teachers' beliefs, classroom practice and beliefs are disjointed. Maxion (1996) identifies certain external and internal factors affecting teachers' beliefs and practices. The former include life experience, educational experiences, classroom events, school curriculum requirements, students, administrative demands, theoretical knowledge, educational policy, family and peers; the latter include personal practical knowledge, culture, values, and personality and internalized external factor (i.e., positive school experience, life experiences and love of the subject).

Mansour (2008a) revealed that teachers' pedagogical beliefs were strongly shaped by personal religious beliefs derived from the values and instructions inherent in the religion. He found that teachers' personal religious beliefs worked as a 'schema' which influenced what was perceived. According to McIntosh (1995) a schema as "a cognitive structure or mental representation containing organized prior knowledge about a particular domain" (p.2). He also noted that schemas were built via encounters with the environment "social context" and could be modified by experience. These beliefs, sequentially, work through the lens of past experiences, since they are translated into teacher practices within the complex context of the classroom.

According to the discussion above indicates that there is more than one social /contextual factors which can effect in shaping teachers' beliefs and practices. These include: work overload, time, working condition, children behavior, relationship with colleagues, lack of resource, year-end test, demand of the curriculum, administrative demand, educational policy, and large class size. Research regarding teachers' level factors still very thin. Gender, subject-matter knowledge and religious factor were taken into consideration in previous research, but so far my knowledge, no research has been found divulging on teaching experience and in-service trainings' influence on teachers beliefs and practices.

2.2.6. Sources of teachers beliefs

According to Knowles (1992), teachers' beliefs are developed throughout their lifetimes and influenced by a variety of factors, including events, experiences, and other people in their lives. Some beliefs are directly adopted from the culture. Some are shaped by experiences framed by culture (Mansour, 2009). For example, each individual shares similar experiences as a child, as a member of a family, and as a parent or teacher. These experiences shape their beliefs about students, curriculum development, and overall schooling process (McGillicuddy-De Lisi & Subramanian, 1996).

Lortie (1975) suggested that teacher education and classroom teaching experience contribute to the development of pedagogical content knowledge, while disciplinary knowledge in teacher education helps to develop subject matter and curricular knowledge among prospective teachers. Accordingly, Shulman (1987) concluded that teachers' beliefs come from four sources: accumulated content knowledge, educational materials and structures, formal teacher education, and "wisdom of practices" i.e., from practical experience.

Experience plays a significant role in shaping teachers' beliefs about teaching and learning processes as individuals in society. Mansour (2008b) identifies two types of experiences: formal and informal. A formal type of experience is represented in the formal education through which teachers have passed, either at school or at university level, or at in-service training courses. The informal type of experiences is represented in teachers' every-day life contacts, past or present that might have a bearing by adding to, refining, adjusting, supporting, challenging, or even changing their beliefs and knowledge.

Experience is seen to filter decisions made by teachers. The kind of experience a teacher has had makes him or her act in certain manner or conducts a certain classroom activity or even under take a professional development activity which, in the end mirrors this experience. With a similar fashion, beliefs have been described as filters through which all new information must pass and which are used to interpret new experience (Kagan, 1992). In this respect, Pajares (1992) indicates that beliefs are created through a process of enculturation and social construction. Therefore, classroom behaviors are the results of beliefs being filtered by experience (ibid, 1992).

2.3. Previous research regarding beliefs and instructional practices

Brown and Melear (2006) explore science teachers' beliefs and practices with regard to inquiry oriented instruction. They analyzed the relationship among secondary science teachers' preparation, their beliefs and their classroom practices after completion of a course designed to provide authentic inquiry experiences. From Teacher Pedagogical Philosophy Interview data and Secondary Science Teacher Analysis Matrix observational data, they analyzed links between the teachers' conveyed beliefs and observed practice regarding teachers' action (TA) and students' action (SA). Also presented is a listing of teachers perceived influences from university preparation course work. Results indicated that 7 of the 8 teachers professed a belief in teacher-centered or conceptual style with regard to TA and SA. Inconsistencies between interview and observational data were unexpected, as half of the teachers professed slightly greater teacher-centered styles with regard to TA than what they actually practiced in their classrooms. All teachers reported that an inquiry-based science course was valuable.

Verjovsky and Waldegg (2005) explore the beliefs and practices of a high school biology teacher through three interrelated theoretical frameworks: common knowledge, collaborative learning, and communities of practice. The data were obtained from an in-depth case study of Maria, a biology teacher from a Mexican public high school that was participating in a 4-year international science project using collaborative learning and information and communication technology. Her beliefs and practices were explored by means of questionnaires, semi-structured interviews, and non-participants observation of classes. Results indicated that the degree of coherence between practice and beliefs that guide the teacher's daily behavior become apparent, as well as the difficulties of incorporating innovations due to instructional constraints.

Tsai (2002) categorized student teachers' beliefs about teaching, learning and science as traditional, process oriented, or constructivistic. Data was collected through interview. In his study, the majority of 37 Taiwanese science teachers held traditional beliefs. More importantly, over half of these student teaches has beliefs about teaching, learning and science that that were closely aligned. Tsai (2006) performed an evaluation of the relationship between the different beliefs. He concluded that "adequate coherence" existed between the subjects' scientific epistemological beliefs and their classroom teaching.

Levitt (2002) in his study tried to ascertain the beliefs of elementary teachers regarding the teaching and learning of science and the extent to which the teachers' beliefs were consistent with the philosophy underlying science education reform. Sixteen teachers from two school districts involved in a local systemic initiative for science education reform participated in the study. Data was collected through classroom observation and interview with the teachers. One overarching belief emerged: teachers believed that the teaching and learning of science should be student centered. The study also revealed gaps between teachers' beliefs and the principles of reform and suggested that the teachers are moving in a direction consistent with science education reform.

Markic and Eilks (2010) described a broad and triangulated picture about the science student teachers' beliefs on teaching learning science from four different domain of science teaching. A mixed method approach was adopted to conduct this research. The results suggest that beginning chemistry and, even more pronouncedly physics student teachers profess quite traditional beliefs about teaching and learning science. Biology and primary science student teachers express beliefs towards teaching and learning in their subjects more in line with modern educational theory.

Aguirre et al., (1990) showed that science student teachers often conceptualize teaching as 'a knowledge transfer' or an influence or change in understanding'. They view learning as 'an intake of knowledge,' 'an attempt to make sense in terms of existing understanding' or 'an effective response'. Koballa et al., (2000) described German chemistry student teachers' beliefs as reproductive rather than constructive. Fischler (1999) evaluated German physics student teachers' beliefs in terms of thinking about their own physics classes at school. The usual response was a very dominant teacher, vary passive pupils, and bad images of physics.

In Germany, Niehaus and Vogt (2005) performed a study with Biology teachers and student teachers. The study showed that biology (student) teachers' beliefs are a mosaic of different categories and cover a wide range without showing any clear tendency towards more conventional or more traditional beliefs.

Brooks and Brooks (1993) found that teachers are predominantly teacher-centered and generally behave in a didactic manner, disseminating information to students. This has been suggested to result from a paramount concern with behavioral control and the belief that teacher-centered whole-class lessons are most conducive to quiet classroom (Becker, 1991).

Hashweh (1996) studied 35 Palestinian science teachers in order to see the effect of beliefs on teaching practices. Data was collected thorough questionnaire survey. He categorized the science teachers as either constructivist or empiricist (as defined by a questionnaire). He found that the constructivist teachers were more likely to recognize students' alternative conceptions and to indicate they would use a variety of teaching strategies than did empiricist teachers. Hashweh argued that constructivist teachers view the development of knowledge as residing at the student level and as a result view science as process of conceptual change. Thus, the teachers in this study selected instructional strategies that were congruent with their beliefs about science and science learning. In brief, he found that constructivist beliefs corresponded with constructivist behavior.

Uzuntiryaki et al., (2010) explore Turkey's pre-service chemistry teachers' beliefs about constructivism and the influence of their beliefs in their teaching practice. Data were collected through semi-structured interviews, observation note and lesson plan. Pre-service teachers' beliefs about constructivism were classified in three categories which are weak, moderate, and strong conception of constructivism. For detailed exploration, three cases of pre-service teachers representing these three categories were selected. The findings of the study showed that most pre-service teachers of this study did not have a strong conception of constructivism and the relationship between the pre-service teachers' beliefs and practice was not clear-cut.

A case study by Richmond and Anderson (2003) of three secondary science teacher candidates clearly revealed the influence of their epistemologies on practices. One teacher's beliefs about science as a body of facts shaped his planning and teaching. Furthermore, his focus on science as facts led him to assess low-level understanding rather than conceptual development. Another teacher viewed her primary role as a science teacher as helping students appreciates science. As a result she spent her planning time creating an engaging instructional setting and much less time on determining if students had developed the targeted scientific understandings.

Zipf and Harrison (2003) conducted a qualitative case study of two Australian elementary science teachers and examined the relationship between these teachers' belief and their teaching practices. Patty, a more traditional teacher, tended to use worksheets and emphasize content. Furthermore, Patty believed the textbook was the tool that allowed her to meet the wide variation in her students' abilities. In contrast, Tina wanted to use a textbook that would support her belief in teaching relationally and would allow her students to experience and actively participate in science. The differences in these two teachers' beliefs about teaching and learning were further translated into their assessment practices. Tina used open-ended formative assessments in her instructional unit to provide her with continuous feedback on student learning, whereas Patty "favored end-on marks-based assessment techniques focusing on science content and felt that she must have marks".

Yang et al., (2008) investigated the views about constructivist instruction and personal epistemology of the secondary earth science teachers in Taiwan. Participants were assessed through a paper-and-pencil survey and a *Learning environment preference questionnaire* (LEP) designed to explore personal epistemology. On a five-point Likert scale, teachers, on average, showed a neutral agreement on constructivist instruction. The content analysis suggested that teachers held alternative views about the nature of the constructivist instruction. LEP scores were found to be statistically associated with gender, education, current teaching level and years of teaching; the score distribution indicated that most teachers had not developed a constructivist-compatible epistemology. By one-way ANOVA, it was suggested that views about the constructivist instruction were aligned with personal epistemology.

Chai et al., (2006) examine Singaporean pre-service teacher epistemological beliefs on teaching and learning. Data was collected through questionnaire survey. The results indicate that Singapore pre-service teachers were fairly homogeneous in their beliefs. They place much emphasis on learning effort. Although they seem to be inclined to believe that knowledge is uncertain, they also tend to belief in the experts. Generally, the profiles suggest that it may be necessary for Singapore teacher educators to foster more mature epistemological outlooks among its pre-service teachers.

OECD (2009) conduct international survey for collecting data regarding teacher's beliefs on teaching-learning. Twenty two countries participated in this study. The data was collected through questionnaire survey. Results show that in all countries but Italy the average endorsement of modern (constructivist) beliefs is stronger than that of direct transmission (traditional) beliefs. Regarding teachers role, in most countries, teachers hold modern beliefs. They believe that their task is not simply to present facts and giving their student opportunity to practice. Regarding student role, in most of the countries, teachers hold modern beliefs. They believe that they should support students in their active construction of knowledge. Besides this general agreement on beliefs about instruction, countries differ in the strength of teachers' endorsement of each of the two approaches. The preference for a modern view is especially pronounced in Austria, Australia, Belgium, Denmark, Estonia and Iceland. Difference in the strength of endorsement are small in Brazil, Bulgaria, Italy, Malaysia, Portugal and Spain. Hence teachers in Australia, Korea, north-western Europe and Scandinavia show a stronger preference for a modern view than teachers in Malaysia, South America and Southern Europe. Teachers in eastern European countries lie in between. Results indicate that there is a correlation between constructivist beliefs and student-oriented practice and enhanced activities.

Haney et al., (2003) examines the perception of teachers, administrators, parents, community members and high school student about the science learning environment. The participants were active members of a grant project aimed at creating community action teams. Varrella and Burry-Stock's (1997) Beliefs about Learning Environment (BALE) Instrument was used as a theoretical model for constructivist belief identification and comparison. Results indicate that although beliefs varied greatly, the administrator and teachers possessed the most constructivist beliefs. The authors suggest that identifying the beliefs of teachers, as well as those of the entire school community, is crucial.

More recently, educational researchers have focused on advanced epistemological beliefs. These beliefs concern teachers' views about teaching strategy, teacher's role, student role, learning environment and learning content. These beliefs are intertwined with teachers' beliefs about teaching-learning as how a teacher conceptualizes knowledge impacts their teaching beliefs (Brownlee et al., 2002). Pajares (1992) and Richardson (1996) stated that multiple forms of data were needed in order to understand such advanced epistemological beliefs. So there is call for close examination about beliefs to understand the relationship between beliefs and instructional practices.

According to the above discussion it can be concluded that research regarding teachers' beliefs and practices are still scarce in Asian countries. Very few research regarding teachers' beliefs on teaching-learning divulge teachers' views on teaching strategy, teacher's role, and student' role but no research has been found reporting yet on teachers' views about learning environment and learning content aspects of teaching-learning. Most of the researches regarding beliefs and practices have been conducted with student teachers and beginning teachers, research with in-service teachers in real classroom settings seems to be relatively thin. Besides, most of the research with in-service teachers collected self-reported data through surveys regarding their practice without classroom observation (Beck et al., 2000; Hashweh, 1996; Haney et al., 1996; Hancock & Gallard, 2004) or with few observations (Haney & McArthur, 2002; Mellado, 1998). In addition to that most of the researches did systematic lesson observation in order to explain practices. To my knowledge no research has been done yet regarding ethnographic lesson observation through video. Although it has some challenges (see Roschelle, 2000) there are many strong reason for choosing video as medium of data collection: videotape can preserve more aspects of interaction including talking, gesture, eye gaze, manipulatives, and computer displays. Moreover, video allows repeated observation of the same event and support microanalysis and multidisciplinary analysis. Video can avoid the "what I say" versus "what I do" problem that can occur in self-reports (systematic observation) (Ibid, 2000, p. 709).
Since there was no protocol analysis (ethnographic lesson observation), the previous researches could not be able to answer the following questions:

- What type of questions are asked by the traditional or constructivist science teachers?
- What type of student responses are triggered in the lesson conducted by the traditional or constructivist science teachers?
- What type of reaction traditional and constructivist teachers offer to students' different responses?
- What degree of power and control related language in lesson discussion is used by the traditional or constructivist science teachers?

Therefore, through this study an effort was made to examine closely teachers beliefs with multiple data sources with a view to revealing some actuality and holistic ideas about in-service science teachers' beliefs on teaching-learning aspects, and how teachers' reflect their beliefs through teaching practices in real classroom context in Bangladesh.

2.4. Teaching approaches

Teaching itself has traditionally had a number of meanings, as the concise Oxford Dictionary shows: to give systematic information to a person (about subject or skill); to practice this professionally; to enable a person to do something by instruction and training (to swim, to dance); to be an advocate for a moral principal (my parents taught me forgiveness); to communicate, instruct in a moral principle; to induce a person by example or punishment to do or not to do a thing and; to make a person disinclined to do a thing (Jarvis, 2006, p. 3). Teaching practices or actions are considered to be knowing-in-action (Schön, 1983) or observable pedagogical behavior (Good, 1996; Fishbein & Ajzen, 1975). Teaching practice or instructional practice of science teachers are those actions exhibited by them in class intended to bring about a change in behavior in the students (Beccles, 2012). In other word, these are basically the classroom practice (teaching and learning practices) of science teachers during instruction, and include actions such as teaching method and strategies. Flanders (1970) defines teaching "as a collection of interaction that consist of series of events between teachers and taught". Teaching is action which leads to shared contacts between the teacher and the pupils and the interchange itself is called teaching. Therefore, in the present research, teaching practice or instructional practice will be regarded as the collection of interaction of science teachers and their taught in a classroom context which include teaching methods and strategies.

Three main styles of teaching practices are propounded: didactic, Socratic and facilitative under two main philosophical ideas; teacher-centered and student-centered teaching approaches (Jarvis, 2006). The diversity of styles provides a degree of flexibility that allows one to alter the task of teaching whether it is teacher-centered or student-centered. The next sections give details about the teaching approaches.

2.4.1. Didactic teaching approach

The didactic approach to teaching primarily involves lecturing and is essentially teacher-centered (Griffin, 2006). Lecturing is the usual classroom "chalk and talk" method (Das, 1985) and probably the most frequently employed teaching technique (Griffin, 2006). It is an economical means of transmitting factual information to a large audience, which rarely creates interest or draws attention of the young people. Here the teacher talks and the class listens; thus, the teacher is the only active individuals in the class and the pupils are passive listeners (Das, 1985). Lecturing is one the best representing feature of the non-interactive or authoritative approach of teaching by which teacher presents normative ideas in a monologue (Mortimer & Scott, 2003). In 'direct lecturing' little or no contribution is asked of, or offered, by pupils (Edwards & Mercer, 1987). They asserted that direct lecturing is one of the pedagogical interventions where teacher control is at an increasing level. Griffin (2006) stated that lecturing is a didactic method relies upon various form of authority. Three types of authority which lecturing represents are: *social authority* (monopoly of knowledge and expertise), *subject authority* (knowledge authority*)*, and *professional authority* (planning and structuring the lecture) which didacticism reflects (*ibid*. p.77.). In addition to that, lecturing put the lecturer in complete control of the learning situation, and seems to cast the leaner in an entirely passive role (Griffin, 2006). Lecturer who follows this method sees the teacher's task to be the evaluation and correction of the learner' performance, according to criteria of which s/he is guardian (Barnes, 1973, as *cited* in Mansour, 2009). In order to control the learning content and control learner's behavior, lecturers ask closed question which triggered detached or word or phrase type response (Mansour, 2009; Wilen, 1991). The most critical constraints that lecturing produce is "one-way communication" along with others constraints which involve rote learning, learning by note taking, potential boredom as the approach limits student participation and reflection (Griffin, 2006).

2.4.2. Facilitative teaching approach

Radical pedagogies have challenged conventional classroom practice where student is the recipient of new knowledge and the teacher is the knower (Weimer, 2000). Teaching is "no longer seen as imparting knowledge and doing things the students, but is redefined as facilitation of self-directed learning (Tight, 2002).

Facilitation is associated with student-centered learning. It is an ancient art; it had a place in spiritual and monastic tradition in the form of guides, spiritual masters, and spiritual directors where it flourishes (Gregory, 2006). Literally facilitation means "easing" by which drawing out the wisdom already embedded and lying dormant in the psyche of the learner. Facilitation may thus be seen as re-awakening our latent talents and store of unconscious wisdom. It is the art of helping learners realize their capacity to learn is the hallmark of the facilitator, moving education from a delivery of static knowledge to a dialogical relationship where knowledge is co-created (ibid. 2006, p.99). Facilitation is the educational skill of accessing the phenomenological world of the individual, textured in social and cultural variables and helping the learner get in touch with their internal capacities to learn and to make sense of their experiences.

According to Gregory (2006), facilitators are people with the skills to create conditions within which other human beings can, so far as is possible, select and direct their own learning and development. Facilitative approach of teaching thus, teases out previous learning and helps students "make sense" of experiences in relation to real world events. In order to facilitate learning, teachers must be competent, possess self-esteem, hold authority within classroom, show compassion, respect for individuals and be flexible in the range and style of teaching methods. They can be challenged and should be able to form relationship between themselves and the students (Freeth & Parker, 2003). The relationship they form is side-by-side rather than face-to-face; both look out onto the same world and have a prolong conversation about what they are experiencing and how they are making sense of their experience (Gregory, 2006). The facilitator' role is one that encourages students to engage in intellectual analysis, critical thinking, problem solving, describing experiences (Gregory, 2006) and challenge learning (Jervis, 2006). Challenge is as aspect of learning facilitation that is commensurate with transformational learning (Entwistle, 1997).

Different styles of facilitation are established. However, critical pedagogy is the most facilitative style of facilitation, as it hands over the responsibility for learning to the student as they debate cognitive and intuitive perception (Preece & Griffin, 2006). These features are commensurate with the development of academic awareness and clinical reasoning skills in students and concur with the characteristics of student empowerment (Bookfield, 1996).

2.4.3. Socratic teaching approach

The Socratic method of teaching emphasizes student-centeredness and strongly opposes didacticism. Socratic teaching is revered as the oldest, most powerful model for development critical thinking. This teaching model, established by Socrates more than 2,500 years ago, emphasizes the importance of seeking evidence, closely examining reasoning and assumptions, and analyzing basic concepts. With Socratic teaching, the focus is on providing students with questions, not answers, by modeling inquiry and probing. As a result, students develop the ability to reason in a disciplined, self-assessing manner. Students also benefit by communicating with their peers through discussion in the classroom setting (Jarvis, 2006).

Through questioning teachers: helping learners to recall pre-conscious learning or tacit knowledge and leading learners through a carefully constructed sequence of questions towards a pre-determined conclusion (Jarvis, 2006). He specifies at least four different ways in which teacher can teach through questioning:

- Helping learners to call to mind what they have learned pre-consciously or their tacit knowledge
- Leading learners through a carefully structured sequence of questions to a pre-determined answer

- Starting learners on a questioning process which is totally unstructured at the outset
- Having question and answer tests to aid memory recall (ibid., 2006, p. 92).

However, the questions put by the teacher should be clear, distinct and unambiguous but thought-provoking. The questions should neither be too easy nor too difficult but should be of appropriate difficulty so as to be relevant to the ability of the pupils (Das, 1985). Chin (2007) identifies Socratic questioning under the categories: pumping, reflective toss and constructive challenge. Through *pumping* teacher encourage students to provide more information via explicit request; by *reflective toss* teacher pose question to a prior utterance made by student with the intension to throw the responsibility of thinking back to the student; while by *constructive challenge* teacher pose a question that stimulates student thinking instead of giving corrective feedback (Chin, 2007).

Jarvis (2006) mentioned that there are a number of dangers when teacher lead sessions through questioning: first, that nobody will answer; second that teacher intervene and direct the question at a student in the hope of getting an answer; third, that someone will dominate; fourth, that there will be some who do not participate and fear of embarrassing student through asking them directly. However If teachers successfully handle those dangers, they can teach without communicating information.

OECD (2009) identifies teachers' pedagogical action into three dimensions: *structuring practices* (correspond to teacher centered teaching); *student-oriented practice* (Correspond to student-centered teaching); and *Enhanced activities* (Correspond to student-centered teaching). According to OECD (2009), "*structuring practices*" includes teacher's action such as "state learning goals; summary of earlier lessons; homework review; checking the exercise book; and checking student understanding during classroom time by questioning students". "*Student-oriented practices*" includes teacher's action such as "students work in small groups to come up with a joint solution to a problem or task; ability grouping; student self-evaluation; and student participation in classroom planning" while "*Enhanced activities*" involves the actions such as "students work on projects that require at least one week completing; making a product; writing an essay; and debating arguments". Following sections will explain about teachers' instructional behavior such as question and questioning; feedback; classroom discourse and interactions.

2.4.4. Literature regarding questions and questioning

Effective learning is the main concern of science education. Effective learning happens best where social interaction, particularly between learners and more knowledgeable others, is encouraged. Teaching styles, therefore, need to take account of the need for discussion, both between pupils and between pupils and teacher (McCormick & Leask, 2005). Cormack et al., (1998) stated that teachers can be highly influential in shaping classroom discussion so that it aids students' deep learning. Kawalkar and Vijapurkar (2011a) asserted that teachers can provide this support and guidance through questions. Teachers' questioning is significant aspects of classroom talk and asking question is one of the 10 major dimensions for studying teachers' behavior in the widely used system for Interaction Analysis (Flanders, 1970; Ewing & Whittington, 2007). Using questioning technique, for example, Socratic questioning, the teacher acted as an interlocutor and a coach who provided scaffolding through asking guiding questions to advance students' thinking (Chin, 2007). With a similar vein, Aschner (1961) stated that asking question is one of the basic ways by which the teacher stimulates student thinking and learning.

The kind of questions teachers ask and the way in which they are asked can, to a large extent, influence the nature of students' thinking as they engage in the process of constructing scientific knowledge (Chin, 2007) and can become indices of quality teaching (Carlsen, 1991). In the inquiry and conceptual change classroom teaching, the nature of teachers' question and their purpose differ greatly with the questions those asked in traditional teaching (Kawalkar & Vijapurkar, 2011a; Chin, 2007, Yip, 2004). Purpose of questioning, for example, in traditional teaching is to evaluate what students know and following a particular structure of Initiation-Response-Evaluate (IRE) sequence (Lemke, 1990) whereas, eliciting what students think, encourage them to elaborate on their thinking and help them to construct conceptual knowledge, is the purpose of inquiry teaching (Baird & Northfield, 1992).

2.4.4.1. Classification of teachers' questions

Teacher questions are frequent, pervasive, and universal phenomena (Roth, 1996) and prominent features of classroom talk (Wellington & Osborne, 2001; Blosser, 2000). Teachers ask many questions (Gall, 1970), sometimes an over hundred questions in a class session to encourage students thinking.

However, the types of questions teachers ask are more important that the number of the questions asked by the teachers. Several categories of teachers' questions have been proposed by many researches. Well known among these are lower and higher order questions (Bloom et al., 1956), and open and close-ended questions (Graesser & Person, 1994). Lower cognitive, corresponding to close-ended question, are those that invite brief answers and place few cognitive demands on the student while open-ended or higher-cognitive questions invite extended answers, may have several acceptable answers and place more demands on the learner (Kawalkar & Vijapurkar, 2011a). Wilen (1991) concluded that teachers use questions to deal with both instructional and managerial tasks. Blosser (2000) identified questions as falling into one of four categories: Managerial-type, rhetorical-type, open-type and closed-type. *Managerial* questions are those used by the teacher to keep the classroom operating and *Rhetorical* question are used by teachers to reinforce a point or for emphasis (2000, p.4).

Kawalkar and Vijapurkar (2011a) found five broad categories of teachers question in inquiry classroom: *exploring pre-requisites or setting the stage*; *generating ideas and explanations*; *proving further*; *refining conceptions and explanations and guiding the enter class towards the scientific concept*. They reported that traditional teachers ask few open-ended questions. Yip (2004) identified 10 types of questions under four broad categories namely: lower order, higher order, motivational and conceptual change. He asserted that the "conceptual-change" questions, unlike most traditional questions, play a distinctive role in science instruction in that they aim at facilitating students to undergo conceptual change and construction (2004, p.78) through eliciting preconception or alternative conceptions, challenging students to review and resolve inconsistent ideas, extending students idea from existing knowledge and applying the knowledge in novel situation. He reported that lower order questions were frequently asked by the teachers (35.1%), the proportion of higher order question (25.4%) and conceptual-change question is also constitute a significantly high percentage (27.4%).

Chin (2007) analyzed teacher's questions in science classroom. She described four approaches namely *Socratic questioning*, *Verbal jigsaw*, *Semantic tapestry* and *Framing* and several strategies within these approaches that encourage student responses and thinking.
Previous studies on teacher questioning focused on the recitation or the IRE (Initiation, response, evaluation) pattern of discourse (Mehan, 1979) and the importance of wait time in increasing students' thoughtfulness (Tobin, 1987). Dillon (1985) discussed the lack of student active engagement when teachers asked too many question based on IRE format. He asserted that prevalence of evaluative questions of the IRE format in classroom talk would be counterproductive to students articulating their thought.

2.4.4.2. Use of teachers' question in inquiry

The purpose of teacher questioning in traditional lesson is to evaluate what students know (Lemke, 1990) in which, teacher asks a closed question that is basically information-seeking, that requires a predetermined short answer and that is usually pitched at the recall (Goodrum, 2004) or lower-order cognitive level. However, in inquiry oriented science classrooms or constructivist classroom, the role of teachers' questions is to encourage true dialogue (Lemke, 1990) aiming at conceptual understanding. Such questions are more open requiring one- or two-sentences answers, and the teacher engages students in higher-order thinking (Baird & Northfield, 1992). Goodrum (2004) stated that in inquiry teaching the main engine for facilitating learning is the use of questions and discussion while in traditional lesson the driving force of teaching is teacher explanation.

Roth (1996) described a case study where the teacher's questioning was designed to 'draw out' students' knowledge and scaffold students' discursive activity to lead to independent accounts and student-centered discussion. Erdogan and Campbell (2008) found that teachers facilitating classrooms with high levels of constructivist teaching practices not only asked a significantly greater of number of questions but also more open-ended questions.

Beccles (2012) studied teacher intensions by using the teacher questions and the purposes of the questions during science lessons in Ghana. He found that the intention of the teachers questions were mainly to check students focus in lesson (38%) and students' prior science content knowledge (42%). Less emphasis was given on checking students' procedural knowledge (2%), checking students' understanding (5%), and eliciting student thinking (8%). To promote meaningful learning that can solve real life problems, students need to be asked a variety of question (Blosser, 2000). To develop variety in questioning teacher need to know what kind of questions they currently ask.

2.4.5. Literature on feedback

Feedback is conceptualized as information provided by an agent that is teacher, peer, book, parent, self and experience (Hattie & Timperley, 2007). Feedback and instruction are inseparable (Kulhavy, 1977) and a powerful tool to enrich deep learning and critical component of assessment for learning (Marzano, 2007). Feedback is an essential construct for many theories of learning and instruction, and an understanding of the conditions for effective feedback should facilitate both theoretical development and instructional practice (Bangert-Drowns et al., 2013). To take on feedback into instructional purpose, it needs to provide information specifically relating to the task or process of learning that fills gap between what is understood and what is aim to be understood (Sadler, 1989), and it can do this in various ways, for example, increased effort, motivation, or engagement (Hattie & Timperley, 2007). Alternatively, the gap may be reduced through a number of different cognitive processes, including restructuring understandings, confirming to students that they are correct or incorrect, indicating that more information is available or needed, pointing to directions students could pursue, and indicating alternative strategies to understand particular information (*ibid*. p. 82). A learner can confirm, add to, overwrite, tune, or restructure information in memory through feedback, whether that information is domain knowledge, meta-cognitive knowledge, beliefs about self and tasks, or cognitive tactics and strategies (Winne & Butler, 1994). A learning context is indispensable for feedback to be effective. It is the part of the teaching process and happens second-after a student has responded to initial instruction-when feedback is provided regarding some aspect/s of the student's task performance (Hattie & Timperley, 2007).

2.4.5.1. The role of feedback in teaching-learning process

The power of feedback has frequently been mentioned in articles about teaching and learning. Rahmat (2013), for example, describes a case study result conducted in Singapore of a peer feedback intervention and how its use as part of classroom instructions affected students' learning. She also analyses the teachers' and students' perceptions of incorporating peer feedback to enhance effective teaching and learning. It is, however, found that few studies have systematically investigated its meaning. Hattie and Timperley (2007) provide a conceptual analysis of feedback and reviews the evidence related to its impacts on learning and achievement. Their evidence shows that although feedback is among the major influences, the type of feedback and the way it is given can be differentially effective. A model of feedback is then proposed that identifies the particular properties and circumstances that make it effective, and some typically thorny issue are discussed, including the timing of feedback and the effective of positive and negative feedback.

Another study on feedback conducted by Farquhar and Wesley (2012) about the type and timing of feedback within an intelligent console-operations tutor. They found that when immediate feedback is employed during the acquisition of console-operation skill, elaborative feedback yields greater accuracy of the skill over the use of corrective feedback. They assert that research in the use of feedback in education suggests that *corrective feedback*, or feedback that provides the correct answer is more effective than feedback that simply indicates an error. However, contrary to an information-processing theory of learning, these studies generally find no efficacy for feedback of a more elaborative nature such as the use of additional explanatory information. Chin (2007) identified four different types of feedback-(a) Affirmation-Direct-instruction, (b) Focusing and Zooming (c) Explicit correction-direct instruction, and (d) Constructive challenge-provided by the teachers in their teaching exchange. She stated that unlike feedback types (a) and (c), which did not encourage student input beyond the initial solicited answer, feedback types (b) and (d) further elicited students response, stimulated productive thinking, and extended lines of conceptual thought in students. Analysis of feedback given by the teachers in IRF sequence showed that this was typically in the form of a comment or statement followed by either another question, or further statements that expounded more scientific content (*ibid*, p. 1322). Therefore, the "F" part of the three-part exchange could comprise a "comment-question" (C-Q) or "statement-question" (S-Q) couplet where the question part of the couplet may be regarded as overlapping with the initiation or "I" move of the next IRF sequence. However, if no question were asked, it took the form of a "comment-statement" (C-S) couplet. At times, feedback consisted of only comments (C) or statements (S).

Beccles and Ikeda (2011) reported science teachers' responses to students' incorrect answers during classroom discussion in Ghana. Generally, the science teachers either ignored or rejected students' incorrect answers. Teachers also encouraged students, and engaged in actions such as using, finding out and judging students' incorrect answers. They recommended that science teachers would engage in actions that encourage students and desist from making students feel shy and timidity in Ghanaian classroom atmosphere. Science teachers also need to: use incorrect answers to develop their lessons; create an environment in which every students feels accepted and important during discussion sessions; and factor students' feelings and be sympathetic toward students' incorrect answers in class (ibid, 2011). However, they did not mention teachers' behavior about students' correct or no responses.

Teacher need to make appropriate judgment about when, how and what level to provided appropriate feedback. Most common type feedback is praise usually given by repeating student's initial contribution. However, it was cautioned by Flanders that:

> "…praise without giving reason sometimes interrupts the train of thought of the pupil. Praise without explanation or when given inappropriately led that praise does not motivate. It may more often threaten rather that assure a person of his worth. It establishes the superiority of the praiser and praise may constrict creativity rather than free it…" (1970).

The evaluative feedback known as "*pedagogical interventions*" (Scott, 1998), has many drawbacks in student's meaning-making learning as well as the participation in classroom dialogue. Scott in his research, differentiated forms of pedagogical intervention as degree of level of teacher control. *Elicitation of pupils 'contributions, Marking knowledge as significant and joint, Cued elicitation of pupil's contribution,* treated as lowest level of teacher control , whereas, *Paraphrasing pupils' contribution, Offering reconstructive recaps and Direct Lecturing,* were as at increasing level of teacher control. He asserted that anyone who has spent time in schools will recognize the forms of pedagogical interventions outlined above. However, neutral or evaluation-free feedback has many advantages in developing conceptual understanding. For example, to develop a better inquiry atmosphere in a science class it has been suggested that it is better to avoid comments like 'good boy', 'great answer', and 'well done' (Goodrum, 2004). This approach encourages independent thought and inhibits the common classroom game called "guessing what teacher thinks'. In this game praise is bestowed on students who are successful in reading the teacher's mind rather than thinking for themselves (Ibid. p.61).

The teachers' actions, including the patterns of discourse they establish as well as the interventions (feedback) they employ, greatly influence discussions (Mortimer & Scott, 2003). The type of questions teachers ask and the comments and feedback they incorporate into their classroom impact the nature of the science talk (van Zee & Minstrel, 1997b). The major features of the classroom discourse are discussed in the following sections.

2.4.6. Classroom discourse and interaction

The important role of verbal discourse in meaning-making by students and its significance for teaching and learning, classroom discourse and interaction has been the subject of interest of several researchers (e.g., Cazden, 2001; Edwards & Mercer, 1987; Edwards & Westgate, 1994; Myhill & Dunkin, 2005; Myhill, 2006, Lyle, 2008; Boyd & Markarian, 2011). As stated by Chin

(2006, 2007) that the focus of classroom discourse is mainly the three-part exchange structure known as "triadic dialogue" (Lemke, 1990) or recitation (Wilen, 1991) has been found to be pervasive in elementary and secondary classrooms. This format of discourse is characterized by its familiar teacher initiation (often via a teacher question)-student response-teacher evaluation and has been commonly referred to as "IRE" (Mehan, 1979; Hoetker & Ahlbrand, 1969; Sinclair & Coulthard, 1975). The execution of the recitation format starts with teachers' closed question that is basically information-seeking, that requires a predetermined short answer, and that is usually pitched at recall or lower-order cognitive level. Teacher usually concludes the cycle with some form of evaluation i.e. praises correct answers and corrects those that are wrong. It is sometimes known as the IRF representing initiation, response, and follow-up (Sinclair & Coulthard, 1975), as the third component may not necessarily be an explicit evaluation.

Wilen (1991) asserted that recitation persists primarily because of its inherent controlling nature over interaction and student behavior. With a similar notion, some authors have accorded it a certain functionality that is consistent with educational goals. For example, Newman, Griffin, and Cole (1989) argued that the three-part exchange has "a built in repair structure in the teachers' last turn so that incorrect information can be replaced with the right answers" (p. 127). It is very effective as an instructional method in teaching students to acquire factual information (Wilen, 1991). Such a view is appropriate if we view the responsibility of teachers as ensuring that students appropriate the knowledge is normative within in a particular culture (Chin, 2006). With a similar vein, Wells (1993) has argued that, when used effectively, "it is in this third step in the co-construction of meaning that the next cycle of the learning-and-teaching spiral has its point of departure" (P.35). Therefore, the triadic dialogue could have merit if teachers can scaffold students' extension of knowledge through further supportive dialogue (Bruner, 1986; Vygotsky, 1978).

Dialogue (Lemke, 1990, Scott, 1998) or discussion (Wilen, 1991), in stark contrast to recitation, the second major form of oral discourse is practiced infrequently in elementary and secondary classrooms. The dialogic pattern of discourse is more varied than that of recitation or monologue (Wilen, 1991). Dialogic discourse characterized by comparatively lengthy interactions between a teacher and student or group of students in a context of collaboration and mutual support (Scott, 2009; Wilen, 1991). The pace slows with both teacher and student utterances becoming longer. Mortimer and Scott (2003) identify this lengthy interaction as IRFRF… chain where the elaborative feedback from the teacher is followed by a further student response. As part of the feedback, the teacher could repeat a student's comment to encourage the student to continue, elaborate on the comment, or ask for elaboration. By establishing the dialogical pattern of discourse, teacher is able to explore student's ideas. In the classrooms where the focus is on true dialogue (Lemke, 1990) or conceptual change (Yip, 2004) using constructivist-based instructional approaches (Smith, Blakeslee, & Anderson, 1993), the nature of questioning is different. In such classes, the teacher's intent is to elicit what student think, encourage them to elaborate on their previous answers and ideas, and to help students construct conceptual knowledge. Therefore, questioning is used to diagnose and extend student's ideas and to scaffold student' thinking. Such questions are more open (Wilen, 1991) requiring one-or-two sentences answers, and the teacher engages students in higher-order thinking (Baird & Northfield, 1992). Gall and Gall (1990) concluded that the discussion method is effective in achieving five types of student learning outcomes: (1) subject-matter mastery (2) problem solving, (3) moral development, (4) attitude change and development, and (5) communication skills (Gall & Gall, 1976; Gall & Tom, 1987). Wood and Wood (1988) concluded that teachers can control dialogue through their use of questioning by stifling student initiative. They found that initiative low during recitations and higher during dialogues. Wilen (1991) recommended that teachers (and students) need to learn more about conducting discussions. Training in a variety of questioning and non-questioning techniques is essential to conduct effective discussions (Wilen, 1988).

van Zee and Minstrell (1997a) examined ways of speaking that were characteristic of "reflective discourse". In such interaction student articulated their own ideas and posed questions; and teachers and students engaged in an extended series of questioning exchanges. Teachers helped students develop understandings through a process of negotiation rather than transmission or confrontation of misconceptions. Teaching strategies included soliciting students' conception, restating student utterances in a neutral manner, using reflecting questioning, and invoking silence to foster student thinking.

Scott (1998) characterized classroom discourse into authoritative (typical as IRE) and dialogic based on general features of the discourse, the nature of teacher and student utterances. While authoritative (traditional) discourse focuses on the "information transmitting" voices and has fixed intent and outcome, dialogic discourse involves several voices and has a generative intent. In authoritative discourse, the teacher conveys information and his/her utterances often involve instructional questions, factual statements and reviews. However, dialogic discourse encourages challenge and debate, and is often based on open or genuine questions. For authoritative discourse, student utterances are often given in response to teacher questions, and consist of single, detached words interspersed in teacher delivery. In contrast, they are often spontaneous, expressed in whole phrases or sentences, and are tentative suggestions in dialogic discourse. According to the above discussion table 2.3 summarizes the characteristics of the teaching practices.

Table 2.3. General attributes of teaching-learning styles (Mortimer & Scott, 2003; Jarvis, 2006; Griffin, 2006; Gregory, 2006, Chin, 2006, 2007, Goodrum, 2004; Mansour, 2009; Weimar, 2002)

	Didactic	Socratic	Facilitative
Focus	Teacher-centered	Student-centered	Student-centered
Method	Lecturing; note-giving, individual exercise; routine work	Guiding students by asking sequence of careful questioning	Helping student to 'draw out' prior knowledge through discussion
Patten of discourse	Recitation/Monologue IRE(Teacher-Student-Teacher)	Dialogue IRFRF chain (Teacher-Student-teacher-student-teacher)	Dialogue IRFRF chain (Teacher-Student-teacher-student-teacher)
Nature of questions	Recall, Closed and lower order type.	Open, probing question, reflective toss, constructive challenge,	Balance questioning (mixer of close and open). Open, Higher-order and conceptual change type (eliciting, challenging , extending, and applying)
Nature of responses	Very short limited with word/phrase, and no response type	Generative response, eliciting further thought	Responses are longer, resemble to one or two sentences
Feedback	Evaluative; Praise correct answer; correct wrong answers	Neutral feedback, encourage thought process	Delay judgment; accept and acknowledge students contribution in a neutral rather than evaluative manner.

2.5. Conceptual framework

Plenty of literature suggests that teachers' beliefs about teaching and learning are closely related with classroom practices because they influence the possibility of teachers implementing changes in the classroom (Thompson, 1992). Changes in instructional practice usually reflect the changes in beliefs structures (Cooney, Shaely, & Arvold, 1998). Teachers' beliefs about the nature of teaching and learning shape their classroom behavior. This relationship between beliefs and practices is dynamic meaning that each influencing other. Empirical evidence suggests that changes in teachers' beliefs about teaching and learning are derived largely from classroom practices (Brosnan, 1994; Shulman, 1986). The close linked between beliefs and practice is also supported by Borko (1997) who assert that beliefs are compatible with the ideas that underlie professional development programs, they support changes. Experience plays a significant role in shaping teachers' beliefs about teaching and learning processes as individuals in society. Shulman (1987) identify practical experience-wisdom of practice- is one the four main sources of teachers' beliefs. He also asserted that subject matter knowledge i.e., content knowledge is found other predictor of teachers' beliefs and practices. Gender is another important factor influencing teachers' beliefs and practice. OEDC (2009) claimed that beliefs and practices of female and male teachers may systematically differ. Female teachers are likely than male teachers to see teaching as the direct transmission of knowledge and are most likely to adopt structuring (teacher-centered) and student oriented practices as well as cooperate more with colleagues.

Literature points basically two categories for classifying beliefs about teaching and learning: traditional beliefs about learning and instruction and modern (constructivist) beliefs about learning and instruction. Kim (2005) asserts that these dimensions of these beliefs are well established in educational research at least in Western countries and have also received support elsewhere. The traditional (direct transmission) view of student learning implies that a teachers' role is to communicate knowledge in a clear and structured way, to explain correct solutions, to give students clear and resolvable problems, and to ensure calm and concentration in the classroom. In contrast, modern view (constructivist view) focuses on students not as passive recipients but as active participants in the process of acquiring knowledge. Teachers holding this view emphasis facilitating student inquiry prefer to give students the chance to develop solutions to problems on their own, and allow students to play active role in instructional activities (OECD, 2009). Here, the development of thinking and reasoning processes is stressed more than the acquisition of specific knowledge (Staub & Stern, 2002). This dichotomy regarding teacher' beliefs is not new and has been described by many authors in various studies. Calderhead (1996) placed teachers' beliefs into two categories by arguing that some teachers view teaching as a process of knowledge transmission, while other view it as a process of guiding children's learning or as process of developing social relationships. The beliefs-practice relationship described above constructed the conceptual framework for this study (Fig.2.1).

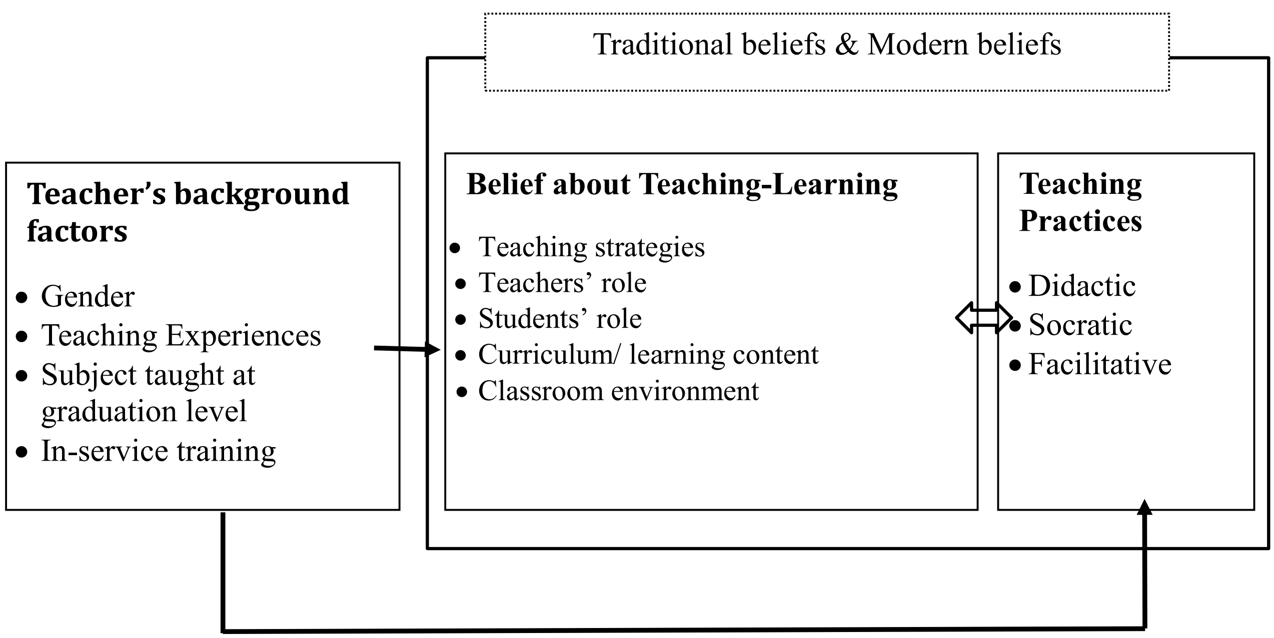

Figure 2.1. Conceptual framework

CHAPTER 3

METHODOLOGY

3.1 Overview of the chapter

This chapter contains information about research method, participants of the study, various research instruments were used, process of data collection, and the method of data analysis. It also includes the validity of the instruments as well as the method of data collection.

3.2. Research Design

The mixed methods research design was employed to carry out the study. This was based on both quantitative approach and field research after purposively selecting the sample (Fig.3.1).

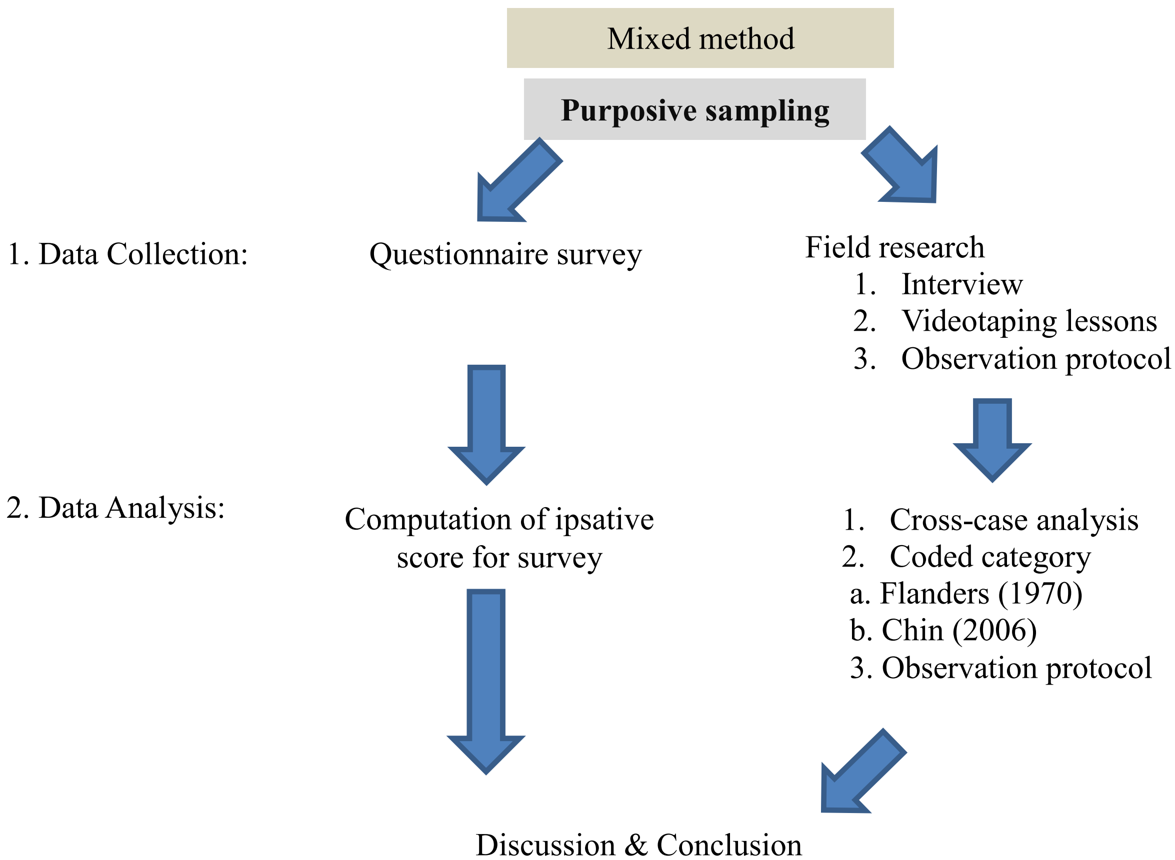

Figure 3.1. Research design

Nonetheless, the study relied mainly on field research like interviews, video recording of science lessons, and direct observations with observation check list (Miles & Huberma, 1994; Tobin, 2000). Interview data and video recorded science lessons were mainly analyzed. This was harmonized with direct observations and survey data to make triangulation. Finally, the results from the analyses were thoroughly discussed and summarized accordingly. Recommendations were offered later to improve the quality of science teaching in the secondary schools of Bangladesh.

3. 2.1. Population and sampling

The target population was secondary schools science teachers and their lessons in Bangladesh. Science teachers from co-education and easy access secondary schools of Dhaka city were purposively selected. In addition to that political unrest of the country, time and money constraint, and the nature of research limit probability sampling. Therefore purposive sampling was adopted. The purposive sampling technique is a type of non-probability sampling that is most effective when one needs to study a certain cultural domain with a specific type of knowledge or skill (Vargas & van Andel, 2005).

3. 2.1.1. Survey participants of the study

This study purposively selected two hundred and fifty three (253) science teachers from secondary schools at Dhaka city (Table 3.1) to gather information regarding beliefs on teaching-learning aspects. Among them 89 was female. The age of the participating teachers ranged between under 25 up to 60 years old with teaching experiences ranged between one (1) year to more than 20 years. Formal education of the participant teachers lay in between bachelor and master; all of them have Bachelor degree in Education (B.Ed.); 116 of them received training on Subject Based Cluster (SBC); Continuous Professional Development (CPD) training received by 136; Teaching Quality Improvement (TQI) training received by 240 teacher participants and 2 of them received 3 months Overseas Training (OT). TQI training, which was started in 2006, mainly focuses on the participatory teaching approach to develop students' understanding and thinking skills of science.

Table 3.1. Demography of the survey respondents

Gender		Age		Experiences (Y)		Formal education		*In-service Training	
Male (M)	164	Under 25	6	1st year	4	Biology	107	B.Ed.	253
						Chemistry	80	SBC	116
Female (F)	89	25-29	37	1-2	16	Physics	66	CPD	136
		30-39	111	3-5	23			CPD	136
		40-49	77	6-10	68			TQI	240
		50-59	20	11-15	64			OT	2
		60+	2	16-20	49				
Total	253		253		253		253		

*B.Ed., Bachelor of Education, TQI, Teaching Quality Improvement; SBC, Subject Based Cluster, CPD, Continuing Professional Development; OT, 3 Month Overseas Training

3. 2.1.2. Interview participants of the study

By using maximum variation sampling technique (Glaser & Strauss, 1967) thirteen of the participant teachers from same pool of survey respondents (see profile in table 3.2) were selected and interviewed. In this case, teaching experience, in-service trainings, gender, and subject taught at graduation level were considered. Among the participants four of them were females. The teaching experiences of the participants ranged between two to seventeen years, held Bachelor degree in Education (B.Ed.), have studied separate subjects of Physics (P) and Chemistry (C) along with either Mathematics (M) or Biology (B) at graduating level, received Teaching Quality Improvement training (TQI), Subject Based Cluster training (SBC), Continuing Professional Development (CPD) training, and short term Overseas Training (OT).

Table 3.2. School wise demography of the interview respondents

School code	Teacher	Sex (M/F)	Experience (Year)	Subject taught*	In-service training**				
					B.ED	SBC	TQI	CPD	OT
A	T1	F	15	P	√	√	√		
	T2	M	2	B	√				
	T3	M	17	C	√	√	√	√	√
	T4	F	6	C	√				
	T5	M	9	B	√	√	√		
	T6	F	14	B	√	√	√	√	√
B	T7	M	10	B	√	√			
	T8	M	12	C	√	√	√		
	T9	M	6	P	√	√			
	T10	M	11	C	√	√	√		
C	T11	M	7	B	√	√			
	T12	F	5	C	√				
	T13	M	8	C	√	√			

*P, Physic; C, Chemistry; B, Biology ** B.Ed, Bachelor of Education, TQI, Teaching Quality Improvement; SBC, Subject Based Cluster , CPD, Continuing Professional Development; OT, 3 Month Overseas Training,

3.3. Data Collection Instrument

This study employed survey questionnaires, interview schedule, video recorder, and observation check list for data collection. Following sections explain about the instruments used in this study.

3.3.1. Survey Instrument

The instrument for data collection of the study is a translated version (*in Bengali*) of Teaching and Learning International Survey (TALIS), originally designed by OECD (2009). The TALIS data collection instrument''-a four-point Likert scale, ranging from 1= "strongly disagree" to 4 = "strongly agree", is used for identifying basic dimensions-the direct transmission view and the modern view- of teachers' belief about teaching and learning (see appendix B). Table 3.3 shows the questionnaire items comprise for two dimensions of teachers' beliefs about teaching and learning.

A careful review of the instrument revealed that the instrument is intended to reflect a "representative sample" of beliefs for each of Schwab's (1958) four common places (teachers, students, curriculum and classroom environment as social milieu) of schooling, plus a fifth category designed to capture beliefs about teaching strategies/ teaching style (see appendix A *Bengali version*).

Table 3.3. Teaching aspect wise revised questionnaire

Item statement	Strongly Disagree	Disagree	Agree	Strongly Agree
Teaching strategies/ pedagogy				
Effective/good teachers demonstrate the correct way to solve a problem.				
Students should be allowed to think of solutions to practical problems themselves before the teacher shows them how they are solved.				
Teacher role				
My role as a teacher is to facilitate students' own inquiry				
Instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly.				
Student role				
It is better when the teacher – not the student – decides what activities are to be done.				
I ask my students to suggest or to help plan classroom activities or topic.				
Classroom environment/learning environment				
Students learn best by finding solutions to problems on their own through working in groups or in peers				
To accomplish a whole class assignment or instruction a quiet classroom is generally needed.				
Learning content/curriculum				
Thinking and reasoning processes are more important than specific curriculum content				
How much students learn depends on how much background knowledge they have – that is why teaching facts is so necessary.				

3.3.2. Interview schedule

The semi structured interview schedule containing six items was developed with the coherence of survey instrument (see appendix C). In the interview protocol the participants were asked about " best ways of teaching; teacher's responsibilities; ideal science teaching environment; best ways of learning science; student's responsibilities; and learning contents" in a desire to develop a deep profile of the participants' beliefs about teaching and learning.

3.3.3. Lesson observation in camera and observation protocol

For the ethnographic observation a high definition (HD) video camera was used, which is sensitive to capture subtle knock of tone, therefore, no extra audio recorder was used. In addition to that systematic observation also conducted. To determine the teaching style of a particular teacher, the study used an observation protocol (appendix D). The protocol contains thirteen deposition statements (Table 3.4) adapted from OECD (2009) which is able to identify particular teaching dimensions: *structure-oriented* teaching (correspond to teacher-centered teaching), *student-oriented* teaching (correspond to student-centered teaching), and *enhanced activities* (correspond to student-centered teaching).

Table 3.4. Content of observation check list

Teaching Dimension	Disposition statement	Observed	Remarks
Structure-oriented teaching practice	State learning goals		
	Review students homework they have prepared		
	Present a short summary of the previous lesson		
	Check students' exercise books		
	Check, by asking questions, whether or not the subject matter has been understood		
Student-oriented teaching practice	Students **work in small groups** to come up with a joint solution to a problem or task.		
	Students **help to plan classroom** activities or topics		
	Students **evaluate and reflect upon** their own work		
	Students work in groups based upon their abilities		
Enhanced activates	Students **work on projects** that require at least one week to complete		
	Students **make a product** that will be used by someone else		
	Ask students to **write an essay** in which they are expected to explain their thinking or reasoning at some length		
	Students **hold a debate** and argue for a particular point of view which may not be their own		

During and after the observation, place a "×" next to those items you have observed.

Adapted from OECD, 2009

Structure-oriented practices were measured with five items which includes-state learning goals; summary of earlier lessons; homework review; checking the exercise book; and checking student understanding during classroom time by questioning students.

Student-oriented practices were measured with four items which includes students work in small groups to come up with a joint solution to a problem or task; ability grouping, student self-evaluation; and student participation in classroom planning.

Enhanced activities were also measured with four items which includes students work on projects that require at least one week completing; making a product; writing an essay; and debating arguments.

3.4. Data collection procedure

3.4.1. Distribution and collection of surveys

Researcher along with three others research assistants were involved in distributing and collecting the surveys. The research assistants were graduate students of the Institute of Education and Research, Dhaka University. As teachers remain busy with various types of responsibilities, they were given time to complete the survey within one week after distribution. A total of 350 survey were distributed while 253 were returned. From February 12, 2012, to March 27, 2012, distribution and collection of surveys were accomplished.

3.4.2. Conducting interview

With due permission of the school heads, the subject was requested to sit for interview. All the interviews were conducted by researcher during the school day in the teachers' school during a free period. The interview began with the researcher giving participants background information of the study and the purpose for the interview. Participants were encouraged to be open and candid in their responses, and assured that they would remain anonymous for reporting purposes. Each interview followed the semi structured interview protocol which is open ended in nature. It lasted for about 25-30 minutes. The interviews were audio-taped and transcribed for analysis.

3.4.3. Video recording of science lessons

Fourteen science lessons of thirteen teachers from three different schools were observed and recorded in February and March 2012 and in April 2013. The science teachers whose lessons were observed gave their consent for their lesson to be videotaped by showing a consent letter issued from my supervisor, Hiroshima University, Japan (appendix E). The observed lessons covered a range of topics (Table 3.5) included in the science syllabus in secondary levels (Grade VI to X). These include motion; living organism and their environment; gas law; state of matter; symbol, formula and valences; work, power and energy; virus; human body; periodic table; plant classification; solution; animal kingdom; chemical reaction and equation; and structure of matter. The average class size was 42 students and average duration of the class was 33 minutes. Due to manpower constraints and the availability of limited video camera for use in class, only classroom discussion in whole-class setting was recorded. The video camera was set up at the middle of the classroom and was directed toward teacher and students. For the video documentation, a high definition (HD) video camera was used, which is sensitive to capture subtle knock of tone, therefore, no extra audio recorder was used. The video files of the recorded classroom talk were transcribed verbatim and ready for analysis.

Table 3.5. School wise lesson topic and grade

School code	Observed lesson topic	Grade level
A	Motion	Nine
	Living organisms and their environment	Eight
	Gas law State of Matter	Nine
	Symbol, Formula & Valences	Nine
	Work, Power & Energy	Nine
	Virus	Nine
B	Human body	Nine
	Periodic Table	Nine
	Plant classification	Nine
	Solution	Seven
C	Animal kingdom	Seven
	Chemical reaction & equation	Eight
	Structure of Matter	Nine

3.5. Data Analysis

3.5.1. Computation of ipsative score for survey

The initial analysis of the survey data revealed that there was a tremendous bias about response to four point Likert-scale. The average mean score of the ten items was 3. 31, meaning that the respondents were near to strongly agree (4) towards the all items' disposition statement. Therefore, this study used ipsative method in order to reduce response bias.

Ipsative scores were computed by subtracting the individual mean across all of the ten items measuring teachers' beliefs from the individual mean across the items belonging to the index *direct transmission beliefs about teaching and learning* and also from the items measuring *modern beliefs about teaching and learning*. Thus, mean scores were calculated for both indices and corrected for the overall tendency to accept any of the belief items. The means across both indices average zero for each teacher. The resulting score of an individual teacher is the relative endorsement of this index or the relative position of the individual on one index in relation to the other index. Positive score values indicate that one set of beliefs receives a relatively stronger support than the other. The ipsative process, a technique which can reduce systematic response bias which exists between groups in a study (Cunningham, et al., 1997). Calculating ipsative scores is an approach to standardizing individual responses to express them as preferences between two or more options and thus helps reduce the effects of response bias (Fischer, 2004 *cited in* OECD, 2009). Since this study, focused teaches having variation in age, education, experience, discipline (Physics, Chemistry, & Biology) and training and given them options in expressing their views therefore, the technique was found appropriate for this study. Figure 3.2 shows schematically the process of counting ispative score.

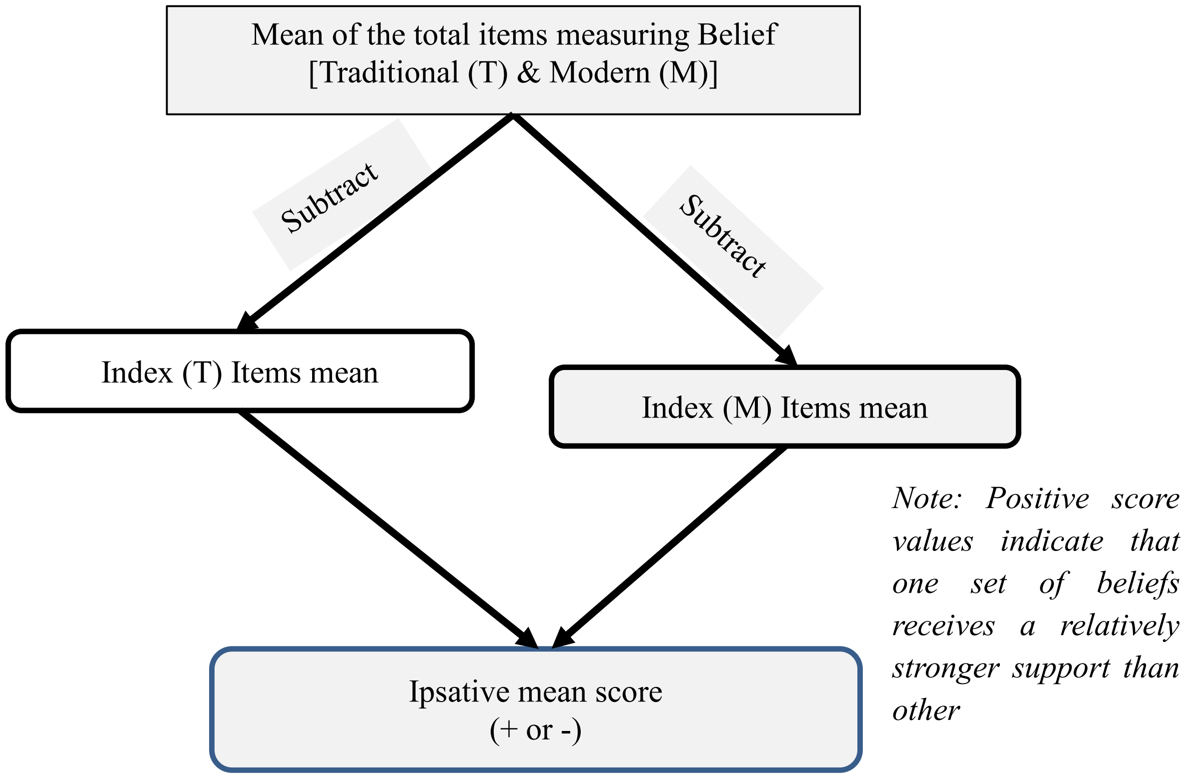

Figure 3.2. Schematic diagram of the process of ipsative score computation

3.5.2. Analysis of interviews

A strategy described by Miles and Huberman (1994) was employed for coding and categorizing of interview data. First of all, audio recorded interviews were transcribed as verbatim. After carefully examining teachers' interview transcripts a summary was developed. After that, the summaries were searched for pattern and or categories. Responses regarding teacher's beliefs about teaching and learning were analyzed into coded categories as either 'traditional' or 'modern' belief dimensions (Fig. 3.3). These categories were then checked against confirmatory or otherwise contradictory evidence in the data and modified accordingly. Thus, conducted several rounds of category generation, confirmation, and modification to satisfactorily reduce and organize the data. This process was repeated for all questionnaires.

A response was considered as *modern belief,* if it was consistent with the modern thought of the teaching aspects as described in the literature review chapter in this dissertation (see table 2.2) and coded as "M". Using the same process *Traditional belief* category was determined and coded as "T". For example, a participants responded that "*the best way of teaching is to give student clear information*", this response was categorized as *traditional belief* and coded as "T" regarding teaching strategies. On the other hand, a participant responded that "*the best way of teaching is to help student to make their own understanding*", this response was categorized as *modern belief* of teaching and coded as "M". An illustrative example regarding category and code was given in the table 3.6.

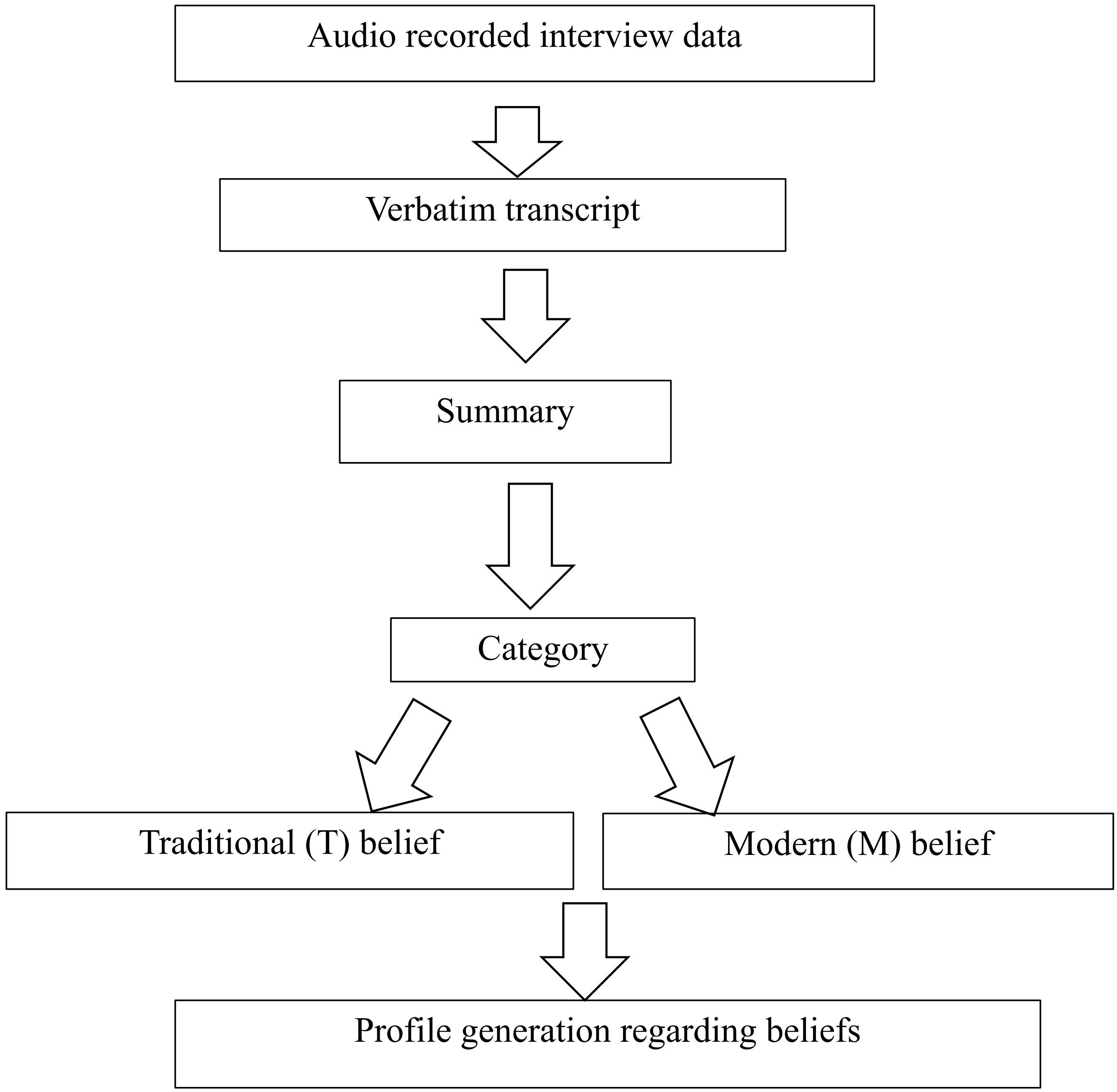

Figure 3.3. Schematic illustration of the interview analysis

Table 3.6. Method of interview data analysis (data gather from PT2)

Interview Items	Teaching aspects	Verbatim transcript	Summary of the responses	**Category**		Code
				Traditional	Modern	
1	Teaching style/ Pedagogy	Our textbook is full of theory, information, and definition. So I believe that the teacher should present this knowledge to the student. They should give student reference book so that they can find that information and learn.	Presenting scientific facts from credible sources	×		T
2	Classroom environment	Science class should very calm and quite. Because if student does not listen teacher talks he/she may miss some important information given by the teachers. As we have only 30-35 minutes, if there is noise we have to spend time to cool down student it definitely cut our lecture time.	Noise less atmospheres for instruction	×		T
3	Teachers' role	Teacher has to be very knowledgeable about the subject he teaches. If he/she transfers wrong knowledge certainly it will do harm to student, so teachers main responsibility is to transfer true and authentic knowledge.	Communication predetermine knowledge	×		T
4	Best way of learning	Science is a difficult subject. Student cannot learn it by themselves. They need help either teacher at school or private teacher. So I think best way of learning science is to listen teacher talk and do practice	Hard working on practicing class work and listen teacher talk	×		T
5	Students' role	Without other help student cannot learn science, so the information given by the teacher is very important for the student to pass the exam. So student should take notes and listen teacher talk.	Listening teacher talks carefully and take notes	×		T
6	Curriculum /learning content	I think teacher should teach definition, theory, process concepts because, if teachers do not teach these things they will not pass and not promote to next grade.	Teaching facts is for passing the exam	×		T

3.5.3. Analysis of lesson observation data

3.5.3.1. The Flanders Interaction Analysis Categories System–FIACS

Teachers' interaction or teaching behavior can be comprehended through the instructions teacher employed in the classroom setting. In order to concretize the classroom interaction, Flanders and his colleagues developed a system called the Flanders Interaction Analysis Categories System (FIACS). It consists on a classification of verbal behavior into 10 categories, under three main sections: the first seven categories include teacher talk, the next two categories include pupil talk and the last tenth category includes the small spans of silence or pause or confusion (Table 3.7).

Table 3.7. Flanders 10 categories

Speaker	Type of utterance	code	Category
Teacher (T)	Response (TR)	**1**	Accept feelings
		2	Praises or Encourages
		3	Accept or uses ideas of pupils
	Initiation (TI)	**4**	Asks questions
		5	Lecturing
		6	Giving directions
		7	Criticizing or justifying authority
Student (S)	Response (SR)	**8**	Student talk-response
	Initiation (SI)	**9**	Student talk - initiation
		10	Silence / No response

3.5.3.1.2. Process of Flanders' Interaction Analysis

The Flanders system involves the categorization of verbal classroom interaction into ten categories by a trained observer. Table 3.8 describes the ten categories. The observer may directly observe the classroom, or he/she may analyze audio recordings, video recordings, or tape scripts of the classroom interaction. At the end of each three-second interval, the observer records the category number which best represents the events just completed. These numbers are recorded in columns to preserve the original sequence of events.

The first step in the process of encoding is to memorize the code numbers, in relation to key phrase of words, which are indicated in bold in the FIACS table (Table 3.7). The observer sits in the classroom in the best position to hear and see the participants. The events are coded by using the Arabic numbers from one (1) to ten (10) which are written down in such a way as to preserve the original sequence. At an interval of every three seconds he writes down that category number which best represents or communication event just completed (appendix- F). Thus the time involves in coding one tally for every 3 seconds, is 20 tallies in one minute, 100 tallies in 5 minutes and 1200 tallies in one hour. Twenty minutes, or about 400 tallies, provide a matrix with sufficient data for a number of inferences about verbal communication (Flanders, 1970). When the observation is over, the observer shifts to another room and prepares the details on the basis of those serial numbers of the categories.

Table 3.8. Coding method for FIACS

Speaker	Type of utterance	code	Category	Description
Teacher	Response	1	Accept feelings	Accepts and clarifies an attitude or the feeling tone of a pupil in a nonthreatening manner. Feeling may be positive or negative.
		2	Praises or Encourages	Praises or encourages pupil action or behavior: repeat the correct answer; repeat the question, nodding head' or saying "um hum?" or "go on" , "very good", "well done" , "thank you" are included
		3	Accept or uses ideas of pupils	Clarifying, building, or developing ideas suggested by a pupil. Teacher extensions of pupil ideas are included but teacher brings more of his own ideas into play, shift to category five.
	Initiation	4	Asks questions	Asking a question about content or procedure, based on teacher ideas, with the intent that a pupil will answer.
		5	Lecturing	Giving facts or opinions about content or procedures; expressing his ideas, giving his own explanation, or citing an authority other than a pupil.
		6	Giving directions	Directions, commands, or orders to which a pupil is expected to comply.
		7	Criticizing or justifying authority	Saying that your answer is not correct; bawling someone out; stating why the teacher is doing what he is doing ; extreme self-reference; "you don't understand", "ignoring student response" are included.
Student	Response	8	Student talk-response	Talk by pupils in response to teacher. Teachers initiate the contact or solicit pupil statement or structure the situation. Freedom to express own ideas is limited.
	Initiation	9	Student talk - initiation	Talking by pupils which they initiate. Expressing own ideas; initiating a new topic; freedom to develop opinions and a line of thought, like asking thoughtful questions; going beyond the existing structure.
		10.	*No student response or silence*	*No response (physical or verbal); pause by teacher or student more than 3 seconds*

For instance, when teacher is lecturing the observer writes 5; when he/she asks a question he/she writes 4; when a student replies the observer puts 8; when teacher praises he/she writes 2; when teacher asks students to sit down, the observer puts 6; when again the teacher starts lecturing, the observer writes 5. In this process only the serial numbers (codes) of the categories are recorded on the data sheet by the observer (appendix F). The above example will generate the following series of category numbers: 5, 4, 8, 2, 6, 5. The Table 3.9 shows an example how to use code symbol in order to identify the category from a lesson transcript.

Table 3.9. An example of real lesson transcript using Flanders method (subject: Biology, topic: virus)

Verbal exchange	**Code symbol**
T (Teacher): look at your textbook and open page 48(1) Look on the board and draw the picture (2) Do you know the name of the picture? (3)	6 6 4
Ss (Students): T2 virus (4)	8
T: look at the shape of its head.(5) What is its head shape? (6)	6 4
S: (student): no response (7)	10
T: What is the shape of its head? (8)	4
S: No response (9)	10
T: shape is hexagonal. (10) It means six arm, 1, 2, 3, 4, 5, & 6. (11), Total body of a T2 virus consists of (12) two components: head and tail (13). The whole body composed of protein cover. (14) Of its head there is cavity (15). Within the cavity there is a double stand DNA (16)	5 5 5,5 5 5 5
S: is there any other shape beside hexagonal? (17)	9
T: What are other parts of it? (18)	4
S: tail, spike, base plate (19)	8
T: tail, spike, base plate (20) Hello, don't talk (21). I will ask you few minutes later. (22) And then all of you should say. (23), Now close your book. (24), Can you tell me? (25) the body of T2 virus composed of what?(26)	2, 6 7, 7 6 4 4

After that frequencies of the code symbol were computed and used to explain classroom interaction. By using the category frequency, classroom situations specially teachers' role of teaching and learning and characteristics of the classroom can be described. Two hypotheses were made: a) the high frequency of the category 1, 2, 3 and 9 represent interactive and dialogic nature of the classroom where teacher indirectly encourage student to learn b) On the other hand, non-interactive and authoritative nature of the classroom interaction is prevailing when the frequency of the category 4, 5, 6 and 8 are high. In this case, teacher shows power and authority and control learning in the classroom.

The FIACS is used to determine whether a teacher is indirect (facilitate) or direct (didactic) in his approach to encouragement and control in the classroom. The system describes, rather than evaluates, teacher behaviors in the order in which they occur, in any subject at any level. Evans (1970) states that the FIACS was effective for investigating the teaching method especially lecture method but does not provide clear relationship between teaching method and teacher effectiveness. In addition to that, it also provides information about power relationship between the teachers and taught through the language criticizing and justifying authority. No other method develop yet to capture students' feeling, using and accepting students' ideas. That is why this study feels necessity using Flanders interaction method as a tool for video data analysis. However, it has some drawbacks which is described in the following sections.

3.5.3.1.3. Drawbacks of the FIACS

The Flanders system has been used by many researchers from the time it was developed. It is an objective and reliable method for observation of classroom teaching. However, researchers, for example, Evans (1970, 1968); Balzer (1968); and Parakh (1965) have identified some limitation of the Flanders system as follows:

- Its failure to include nonverbal behaviors;
- Failure to provide for student-student interaction;
- The system is inappropriate for certain classroom activities, e.g., students working at seats on individualized work, teacher using audio-visuals or tools which do not require teacher talk and students working in small groups and not interacting with the teacher.

In addition to that it is:

- Unable to identify the type of the questions teacher asked (i.e. Open/close type question)
- Nature and purpose of the questions
- Unable to identify the type of responses (i.e. word or phrase type or long response etc.)
- Unable to identify the type of feedback (i.e. neutral/ evaluative)
- As well as the cognitive level of the questions-answers pair.

Thus, this study adapted "Questioning-based discourse analytical method" suggested by Chin (2006) in order to identify question type, response types, types of feedback and their nature and purpose as well as type of thinking. The next section will describe in details about the Method.

3.5.3.2. Questioning-based Discourse Analytical Framework (QDAF)

Chin (2006) developed the method for analyzing classroom discourse based on the scientific content of the talk, type of utterance, type of thinking associated with students' response, and interaction patterns with the framework which is known as "Questioning-based Discourse Analytical Framework (QDAF)". The unit of analysis was the IRF Exchange. Each pair of teacher's initiating questions and the corresponding student's response that is elicited was analyzed, with a focus on the type questions posed, how it was asked, and the relationship between the cognitive level of the question and student's response. This question-answer pair was coded using cognitive category according to the type of responses generated.

To identify the different kinds and patterns of interaction in classroom talk, she traced the questions asked, the responses that they triggered, and how the teacher followed-up on these responses. In particular, she examined the impact of preceding utterances on later ones i.e. follow-up. By examining student utterances before and after a teacher's question, she traced how the question influenced what student said and whether it elicited further thinking.

The present study adapted the QDAF for identifying teacher's questions, student's response and teachers' follow-up and their nature within the framework of analyzing unit IRF. Four aspects of classroom discourse namely content, type of utterance, thinking elicited, and interaction pattern constitute the elements of the QDAF.

Content refers to the scientific ideas and concepts addressed in the discourse. They type of utterance refers to whether it is a question, answer, feedback [statement(S), or comment (C)]. In the context of this framework, a statement refers to further content related propositions made by the teacher, whereas a comment is an evaluative or neutral utterance given by the teacher in response to students' reply to his/her question. The detail method of coding and categorizing for three part-exchanges are described in the next sections. The present study adapted the chin' method for identifying the question, response and feedback form the discussion. *It should be mentioned here that Chin explains detail about the follow-up move but the researcher of the present study adjusts and explains in details about first and second move of the three part-exchanges i.e. teachers' questions and students' responses.*

3.5.3.2.1. Coding method for teacher's questions (I) the first part of the IRF exchange

In deciding which utterances were to be considered as questions, the study focused on those that had the grammatical form questions and intonations of an interrogation were taken to be questions. All questions in the lessons were classified under five major categories: rhetorical, management strategy, lower order, higher order, and conceptual change. The emergent categories were refined by adding to, deleting from, or modifying the existing list. This resulted in a number of sixteen codes which were subsumed under five major categories. The codes depicted specific questions while the major categories characterized more holistic questioning groups. For example, the four codes 'eliciting' (EPA), 'challenging' (RRI), 'extending' (CNK), and 'applying' (UKS) constitute the major category 'conceptual-change' questions. The codes were developed according to each questions cognitive demands and purposes. Beccles (2012) used similar strategy to analyze teachers' intention for posing questions during classroom discussion. In order to determine questions' cognitive demands and purpose, the study taken into consideration the three dimensions of teachers' questioning suggested by Carlsen (1991): the context of questions, the content of questions and the responses and reactions to questions.

Therefore, researcher considered aspects of questioning related to the situational contingencies of the conversations, the development of subject matter knowledge, and the management of turn-taking (Chin, 2007). Table 3.10 shows an illustrative example of these code and categories along with examples taken from various science lessons.

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Table 3.10. Coding method for teachers' question in lesson discussion

Category		Code	Guide line	Examples
Rhetorical question		QR	Questions that do not seek answer directly from the students. Emphasize point, reinforce an idea, or statement	What should I do now? We discussed the matter yesterday, isn't it?
Management strategy questions		MQ	Classroom control and organizational questions	Can you hear me? Are you OK? Is it clear? Where is the captain? Why are you talking or not listening to me?
Lower-order	Checking student knowledge(factual and conceptual), daily life experience, and observation , meaning of the term, read and draw	MT	Question that eliciting the meaning of term	What does virus mean?
		RDL	Question that checking students' ability to read and draw or label	Is it same? Cant' you know the answer? Can you give an example? What it will be?
		CK	Questions that checking student prior content knowledge	Can you tell about previous lesson?
		PAQ	Questions that Providing a predictable answer to a question	What will happen if you mix sugar with water?
		DE	Questions that seek for definition, asking for an example	What is the definition of velocity? Can you give an example of animal virus?
		WP	Question that representing something by a word or phrase,	What is inside of the cavity of the virus?
		ULC	Questions that checking student understanding of lesson content	Can you explain further why diffusion is important?
Higher order	Analyzing	AAK	Questions that checking students ability to analyze knowledge	How would compare diffusion and extraction?
	Evaluating	AEK	Questions that checking students ability to evaluate knowledge	Can osmosis and diffusion occur at the same time in a plant?
	Synthesizing	ASK	Questions that checking students ability to synthesis knowledge	What gases are released by a green plant in day time and night?
Conceptual- change	Eliciting	EPA	Questions that eliciting pre-conception or alternative conceptions	How do viruses spread in the environment?
	Challenging	RRI	Questions that challenging students' to review and resolve inconsistent ideas	The virus carries RNA. Why is it still called animal virus?
	Extending	CNK	Questions that extending students to construct new ideas from existing knowledge	What component of the virus is important? Why do you think so?
	Application	UKS	Questions that check students' ability to use knowledge in novel and concrete situation	How do you keep yourself protected from virus infection?

3.5.3.2.2. Coding method for student's response (R) the second part of the IRF exchange

All the students' responses in the lessons were classified under seven categories: long response express thinking/reasoning, long response expresses information/knowledge, incomplete response, incorrect response, I can't or I don't response, word/phrase response, and no response. Code (CAR)-represents the student's contribution comprise a thought which is similar with a sentence and includes an explanation; Code (CA)-the student's contribution consists of a complete thought resembles a sentence but no explanation; Code (INC)-the answer could not complete by the student or interrupted by the teacher; Code (ICR)- scientifically incorrect responses; Code (ICN)-when student utters, I can't or I don't to a teacher's question; Code (W/P)-the student's contribution consists of word/phrase only; and Code (NR)-there is no student contribution or silence. Table 3.11 shows an illustrative example of these code and categories along with example.

Table 3.11. Coding method for students' response, (R) to the lesson discussion

Code	Category	Description	Example
CAR	Long response express thinking / reasoning	The student's contribution comprises a thought which is similar with a sentence and includes an explanation.	"It's a viral disease that is why medicine doesn't work.'
CA	Long response express information / knowledge	The Student's contribution consists of a complete thought resembles a sentence but no explanation	Body of the virus consists of protein
INC	Incomplete response	The answer could not complete by the student or interrupted by the teacher.	S: it is called…, I think..
ICR	Incorrect response	Scientifically incorrect response	S: body of virus composed of cellulose
ICN	I can't, I don't response	When student utters, I can't or I don't to a teacher's question.	S: I can't sir. I don't sir.
W/P	Word / Phrase	The Student's contribution consists of word or a phrase only	'Yes', 'T2 virus', 'hum' , no sir/madam, velocity, solution
NR	No response	There is no contribution	No verbal or physical response, "remain silent'

3.5.3.2.3. Coding method for teacher's feedback (F) the third part of the IRF exchange

Initial coding schemes for the teachers' feedbacks were developed following an iterative analysis of the transcripts. When teacher' feedback contains content related proposition this was coded as "statement" (S); on the other hand, a "comment" code as (C), is an evaluative or neutral utterance given by the teacher in response to a student's reply to his or her question. When there is comment with question or statement then it was expressed in couplet (C-S) or (C-Q). The intention was to distinguish those aspects of the teachers' science talk that elucidated second-after a student has responded to initial instruction. Each teacher's second contribution to class discussion was coded into one of nine categories: the first four categories were assigned for student's correct or partially correct answer, while the second five categories were represented students' incorrect or no response. Code (C-S)-teacher restate student's scientifically correct response and add more information with student initial contribution in an expository manner, Code (C-Q1)-teacher remains neutral to student correct response by a comment and then asking question, Code (Q1)-after having the correct response from the student, teacher pose a precise question for elaboration, in this case teacher remains neutral, Code (Q2)-teacher tries to take up a side via asking question, thus remain neutral in responding to student's reply, Code (S-Q)-in case of student's incorrect response teacher made precise correction followed by further expounding of the normative ideas and ask question, Code (S)-in case of student's no response or incorrect response, teacher did not make any correction or not make any comment directly go further exposition to transmit normative ideas, Code (C-Q2)-in case of no response, teacher made an evaluative or neutral comment followed by restating the question, Code (Q3)-in case of incorrect response, teacher ask a completely different question in order to encourage student to think, and Code (Q4)-teacher give back student 's incorrect response to student via a question to clarify or self-checking. Table 3.12 shows an illustrative example of these code and categories along with example. Additional examples of all types of teachers' feedbacks are illustrated and discussed in the results sections.

Table 3.12. Coding method for teachers' feedback (F) in lesson discussion

Type of response	Code	Category	Description	Example
Correct /partial correct response	C-S	Restate student response-add more information via exposition	Affirmation and reinforce response followed by further exposition and direction	Student: " Nucleic acid, T: Nucleic acid, it is one of the main components of microorganism. How many types?
	C-Q1	Neutral comment-asking question	Accept response followed by question	T: yes, what is the reason behind your answer?
	Q1	Precise question for elaboration	Asking question to probe or extend conceptual thinking	Can you extend little bit more? What else? What next?
	Q2	Ask student to judge	Shifting authority for evaluating answer from teacher to all	Do you agree with S1 response?
Incorrect/ no response	S-Q	Explicitly correction–direction instruction	Precise correction followed by further expounding of the normative ideas and ask question	S: Cellulose T: it is protein; protein is the main component of virus body. What are other parts of it?
	S	No correction-Direct instruction	Further expounding the normative ideas without correction	T: do you know the name? S: no response T: Such aquatic…, ….are called hydrophytes.
	C-Q2	Restate the question along with comment	Evaluative or Neutral comment followed by restating of the question	Ha. I am asking you about its head shape? Is there any other shape? What do you think?
	Q3	Constructive challenge	challenge via another question	It is same as speed. Like: 13.89 m/s. but where the difference is?
	Q4	Reponses give back to the student via question	Pose a question build on student's prior response	S: this is called osmosis T: Is this osmosis?

An example of questioning sequence based on this analytical framework is represented visually in table 3.13.

In the table 3.13, the column titled “Move” indicates the form of utterance (I, R, or F) while the column labeled “*nature of utterance*” indicates the class of I, R, or F. Entries in the column titled “purpose of utterance” represents the purpose or function of that discourse move (e.g. elicit, reply, probe, extend). The column labeled “type of utterance” indicates whether the utterance is in the form of a question, answer, statement, comment, or a combination of more than one type. The final column entitled “cognitive process” indicates the thinking process associated with students’ utterances. Since it was not possible to gain direct access to the minds of the students, this analysis was inferential in nature and based on what was known about the classroom context (Chin, 2006). The frequency of the class of I, R, or F was used to know the nature of teachers’ questions, nature of students’ response, and the nature of teachers’ feedback. The adaptation of the framework is show in *italics.*

Table 3.13. Sample excerpt based on the "Questioning-based Discourse" framework

Speaker	Utterance	Move	Type of utterance	*Nature of utterance*	Purpose of utterance	Cognitive process
Teachers	We are discussing about ice here. Highest temperature in this graph is 140. *When we heat the ice, in which temperature it transform into water? Please tell me the temperature in which the ice can be transformed into water?*	I	Q	RDL	Check	
Student	0^0 C	R	A	W	reply	Recall
Teacher	Yes, 0^0 C, when temperature reaches to 0^0 C then it will take some time to transform into water. After some time we are giving heat but the temperature remained the same. *Does anyone can say, why? Why the temperatures remain the same?*	F-I	C-Q	EPA	Elicit	
Student	Sir, there may need some heat to change the condition of matter.	R	A	CAR	Reply	Prediction
Teacher	Some heat, the matter has absorbed but didn't change the temperature. *Do you know the difference between heat and temperature? How do you differentiate between them?*	F-I	C-Q	AAK	Accept analyze	
Student	Heat is energy, and the temperature is the condition of heat.	R	A	CA	reply	Analysis
Teacher	So, temperature is the condition of heat, here we have seen that, we have given heat but the heat didn't change the temperature. It did not become hot. We can realize temperature but hotness. So this type of condition is called temperature.	F	C-S		Accept, expound	

Table 3.13 (Continued)

Speaker	Utterance	Move	Type of utterance	*Nature of utterance*	Purpose of utterance	Cognitive process
Student 1	No response	R	A	NR		
Teacher	CuSO4 mix with water, there is a scientific phenomenon. So what is called that phenomenon?	F-I	Q	C-Q2	elicit	
Student1	It is called ….	R	A	INC		
Student 2	it is called osmosis(scientifically incorrect answer)	R	A	ICR	reply	recalling
Teacher	Is this osmosis?	F	Q	Q4	clarification	
Student2	no sir, this is called diffusion because there is hole.	R	A	CA	Reply	Hypothesizing /recalling
Teacher	Yes! This is called diffusion. You have seen that $CuSO_4$ has spread to the whole water. Some of you have shaken it. *What happened when you have shaken the tube?*	F-I	C-Q	C-Q1	Accept expound	
Student	It has happened quickly	R	A	CA	Reply	Observing
Teacher	Diffusion has been happened quickly. *So we can say about some factors that affect of diffusion?*. *What are that factors effect on diffusion?* Number one, who can affect diffusion to happen quickly? How diffusion can occur quickly?	F-I	C-Q	ASK	Accept, expound	
Student1	By shaking	R	A	P	reply	Observing
Teacher	Yes, Shaking, then?	F-I	C-Q	EPA	Accept, expound	

3.6. Validity

Cook and Lincoln (1979 *as cited in* Trochim & Donnelly, 2008) reported that 'the framework of validity in the quantitative tradition involves evidence for internal validity, external validity, reliability and objectivity'. However, according to Guba and Lincoln (1981), the framework of validity involves the verification of truth value or credibility (internal validity), applicability (external validity or generalization), consistency (reliability), and neutrability or confirmability (objectivity) of the data, interpretation and findings.

The survey questionnaire and interview protocol were content validated by two experienced science educators (science teacher educators) of the Institute of Education and Research, university of Dhaka, Bangladesh in February, 2012 before the actual data collection. The consistency of the survey questionnaire was check by confirmatory factor analysis. Survey questionnaire originally designed by OECD (2009) to identify the two basic dimensions i.e. 'traditional and constructivist or modern' beliefs of teachers regarding teaching-learning. The questionnaire consisted of 10 items representing two dimensions. A factor analysis was conducted on the10 items. It is found that the items were segregated according to the beliefs dimensions: five items represents the traditional beliefs regarding teaching-learning loaded in the factor 2 and the five items represents modern beliefs loaded in the factor1. The α for the five items loaded in the factor1 is 0.641 and for the five items loaded in the factor 2 is 0.552. The α for all 10 items is 0.663.

This was done by principal component analysis through Varimax rotation with Kaiser Normalisation to find the factors that could accommodate most items, and factors that contain items that can reasonably be seen to measure the same concept. The results of the factor analysis were shown in the table 3.14.

Table3.14. Matrix of Factor elements

Items	Factor 1	Factor 2	Communalities	Uniqueness	Sum
Item3	0.755	0.134	0.588	0.412	1.000
Item4	0.736	-0.009	0.542	0.458	1.000
Item6	0.618	0.427	0.564	0.436	1.000
Item5	0.582	0.148	0.361	0.639	1.000
Item2	0.470	0.220	0.269	0.731	1.000
Item9	0.058	0.688	0.477	0.523	1.000
Item8	0.088	0.638	0.415	0.585	1.000
Item10	0.108	0.589	0.359	0.641	1.000
Item7	0.335	0.578	0.446	0.554	1.000
Item1	0.200	0.451	0.243	0.757	1.000
	α= 0.641	α= 0.552			
	α for all items= 0.663				
Accumu lation	25.290	14.896			

The video recording of the science lessons was entirely continuous without gap. Completely unedited video and verbatim transcripts of the science lessons were used for the analysis to preserve the content of the classroom verbal interactions captured. All the science lessons were taught in Bengali and were transcribed in English by the researcher. The researcher together with one of the experienced science educators viewed the science lessons and corresponding transcripts to come to agreement on the spoken words both by the teachers and the students in the lessons were transcribed verbatim accordingly.
In order to minimize the video effect some precaution measures were taken. Because “the presence of the camera changing the event being observed” (Roschelle, 2000, p.719). Therefore, some practical steps as suggested by Roschelle were taken to reduce camera effects. They include:

- Explaining and discussing the purpose of the taping
- Practicing “dry runs”; use the equipment in class before starting class
- Using “icebreaker”; make small jokes to relieve tension
- Modeling natural behavior
- Leaving the recording equipment alone during taping.

The data gathering process was also complemented by the interview date from science teachers. Miller and Zhou (2007) reported that individual experiences are more influential the experience of an entire class. Furthermore, “vivid stories of personal experience are more persuasive than statistical evidence” (ibid, p. 322). Thus, the interview data clearly expressed the true feelings and views of the respondent.

In addition, the data of the interview was taken to the source from which they were drawn to verify their truth value. The researcher himself intended “to check that his findings are dependable” (Cohen, Manion, & Morrison, 2007, p. 149) because since “the purpose of the qualitative research is to describe or understand the phenomenon of interest from participants’ eyes, the participants are the only one who can legitimately judge the credibility of the results” (Tobin, 2000, Trochim & Donnely, 2008). After having the interview, the data was transcribed verbatim and give it to back the participants and asked them to indicate whether or not their perspectives are depicted accurately. The purposes of member checks are to test the accuracy of researchers interpretations, by indicating the extent to which participants agree with them (Tobin, 2000, p. 495). The flow chart shows the process of member check done in this study (Fig. 3.4).

Interview with participants

⇩

Verbatim transcript

⇩

Transcript give back to the participants

⇩

Accommodate participants’ comments and suggestions

⇩

Finalizing transcript for further analysis

Figure 3.4. Process of member check

In order to check the reliability of the code developed by Flanders (1970) and Chin (2006) for classroom interaction analysis, inter-rater reliability was calculated. Researcher along with two other rates (educational expert graduated from the graduate school for International Development and Cooperation, Hiroshima University, Japan) coded one lesson by using Flanders System of Interaction Analysis (FIACS), jointly to establish a common understanding. The three raters proceeded by coding all subsequent transcripts independently. The researcher and the raters identified agreements and disagreements, and then discussed dispassionately and in detail the disagreements and agreements that occurred by chance until an agreement was reached. Finally, the inter-rater reliability was calculated by percent agreement along with Kappa value which is 92.9% and 0.882 respectively. The result of the percent agreement is shown in the table 3.15. The results indicate a prefect agreement between the raters and the researcher.

Table 3.15. Percentage agreement along with Kappa value among the raters

Rater	Percent Agreement	Kappa value
Researcher – Rater A	89.4	0.824
Researcher- Rater B	97.6	0.960
Rater A-Rater B	91.8	0.863
Average	92.9	0.882

Similar process was followed also in the case of Chin's coding method and reliability also calculated with percentage agreement, which was 82%. In this case, disagreement between the two raters occurred mainly in the classification of 'higher-order' and 'conceptual-change' questions. The discrepancy was settled through discussion and negotiation between the raters.

The results of the study cannot be generalized to reflect teachers' beliefs and practices in the country but it can be transferred to other samples within the population having similar generalizability context or with proximal similarity patterns (Trochim & Donnelly, 2008) such as same curriculum for in-service teacher training, comparable teacher characteristics, cultural pattern of teaching and learning and cultural backgrounds of both teachers and students. Transferability is a process performed by readers of the research. Readers and teachers of the specifics of the study can compare it to the specifics of the environment or the situation and infer the results in their own situation. As opposed to generalizing to a large population, the study provided ample of description and results about teaching practices so that other teachers, readers, and in-service program developers can judge how the findings applicable to them in their practice. Yin (1994) stated that using multiple case studies strengthen transferability of the results. By studying thirteen teachers classroom practices in relation to their beliefs combined with the espoused beliefs captured from the questionnaire administered to 253 teachers, this study could be transferred to other teachers in a wider perspective. Identification of factors that impede enactment of teachers' beliefs into practice similar to other studies in similar context formed a basis for transferability and credibility of the study.

CHAPTER 4

RESULTS

4.1. Overview of the chapter

This chapter elucidates the teachers' beliefs on teaching-learning aspects, teaching practices, relationship between beliefs and practices and the factors that influence their beliefs and practices. The chapter is divided into three parts. The first part deals with teachers' beliefs in relation to teaching-learning and the factors that influence their beliefs. The second part shows the results of teaching practices and the factors that influence the teaching practices. The third part deals with the relationship between teachers' beliefs and their teaching practices.

4.2. Part I: Results regarding beliefs on teaching-learning and the factors that influence beliefs

Table 4.1 shows the results of the survey of teachers' beliefs about teaching and learning process.

Table 4.1. Ipsative mean score of teacher's beliefs about teaching-learning aspects

Teaching-learning aspects	Beliefs dimension	
	Modern (M)belief	Traditional(T)belief
Teaching strategy or pedagogy	0.37	-0.37
Teacher role	0.43	-0.43
Student role	-0.08	0.08
Classroom environment	-0.05	0.04
Curriculum or learning content	-0.09	0.09

Note: Positive score values indicate that one set of beliefs receives a relatively stronger support than other

The results were analyzed and organized according to teaching-learning aspects with direct quotations selected from interview responses of the participants regarding each aspect. Survey results reveal that science teachers of Bangladesh hold modern beliefs regarding teaching strategy and teacher role in the teaching-learning process. However, they hold traditional beliefs about student role, classroom environment, and curriculum aspects of teaching-learning.

4.2.1. Teaching style or Pedagogies

The mean score value is positive in modern category of belief dimensions (Table 4.1). It indicates that the teacher participants' beliefs regarding pedagogy supported modern approach of teaching. They acknowledged learners as the heart of their instruction generally called student-centered learning. The results corroborate with interview findings (Table 4.2). Seven **(53.8%**) of the interviewed respondents agreed that not teaching but helping or guiding the learners as the heart of their instruction generally called student-centered learning. They expressed their ideas of teaching by using the terms guiding, encouraging, helping students to discuss, to make interpretation, to express their feeling, to make meaning.

However, six **(46.2%)** of the interviewed participants' beliefs aligned to direct transmission belief of teaching (Table 4.2). According to the participants, the best way of teaching is giving the students clear information; presenting scientific facts from credible sources by the teachers generally called teacher-centered teaching.

Table 4.2. Teacher's beliefs about teaching strategy

Teacher (T)	Summary of the interview excerpt	Category
T1	…guiding student to make understanding…	M
T2	…presenting the scientific facts from credible sources…	T
T3	…helping student to make meaningful learning…	M
T4	…giving student clear information **…**	T
T5	…allowing student to express their feelings…	M
T6	…encouraging discussion to make clear conception...	M
T7	…allowing learners to explore by themselves…	M
T8	…helping student to make understanding…	M
T9	…giving accurate explanation…	T
T10	…allowing student to discuss the subject matter…	M
T11	…communicating clear knowledge…	T
T12	…giving student clear ideas about scientific knowledge…	T
T13	…giving student clear information from credible sources**…**	T

M= Modern Belief; T= Traditional Belief

4.2.2. Teachers' role

The participant teachers' beliefs regarding teachers' role support contemporary dimension of beliefs index (Table 4.1). The positive score value of the respondents designate that teacher' role is to monitor student understanding and guide discussion so that all students have opportunities to express their understandings in language and engage in activities such as clarifying, elaborating, justifying, and evaluating alternative points of view. This finding was confirmed by the results of interview (Table 4.3). In responding to the teachers role during interview, seven **(53.8%)** of the teacher participants accredited in teachers' mediating role (Table 4.2). In stating their views regarding teachers role, the participants applied the terms allow student to interact with peers and to learn by themselves; paying attention to students' prior knowledge; let student discuss to come up with a solution; creating learning environment so that learner can work by themselves.

In contrast, six of the participants (**46.2%**) beliefs regarding teachers' role parallel to those of traditional dimension where teachers' role is to dispense accurate knowledge; correct way to solve problem; set learning goal, and check student knowledge by searching predetermined response(Table 4.3). Teachers in this category believed in students' mastery learning. According to the participants, the best ways of learning are finding the right answer; drilling; repeating until mastery; hard working on practicing class work.

Table 4.3. Teacher's beliefs about teachers' role

Teacher (T)	Summary of the interview excerpt	category
T 1	…interacting with student…	M
T2	…transferring true knowledge…	T
T3	…interacting with student…	M
T4	…communicating predetermine knowledge…	T
T5	…paying attention to students' prior knowledge…	M
T6	…allow student learn by themselves…	M
T7	…creating learning environment so that learner can explore…	M
T8	…let student discuss to come up with a solution…	M
T9	…transferring authentic knowledge…	T
T10	…allowing learner to discuss…	M
T11	…transferring authentic knowledge…	T
T12	…communicating subject knowledge…	T
T13	…conveying true and authentic knowledge…	T

M= Modern Belief; T= Traditional Belief

4.2.3. Students' role

The corresponding positive value of student role in traditional belief category (Table 4.1) indicated that the respondents of the study did not give credibility to students as discoverer of knowledge rather thought as passive recipient of the information, listening to explanation from teachers, taking notes, raising questions only occasion. This finding was validated by the results of interview (Table 4.4). All the participants, except three, accredited students as passive learners. Ten of the participants (76.9%) believed that student responsibilities are to cope with what the teachers do; passive listening; memorizing scientific facts and listening teachers talk carefully. Conversely, three of the participants recognized students as independent learners (Table 4.4). They ascribed students as a creator of knowledge as an autonomous explorer.

Table 4.4. Teacher's beliefs about students' role

Teacher (T)	Summary of the interview excerpt	Category
T 1	…seeker of knowledge as autonomous explorer…	M
T2	…passive listening…	T
T3	...active role, seeker of knowledge…	M
T4	…coping what teachers do...	T
T5	…listening teachers carefully…	T
T6	…independent learning…	M
T7	…listening teacher talk carefully…	T
T8	…memorizing, scientific facts…	T
T9	…recipient of information…	T
T10	…copying what teachers do…	T
T11	…taking notes and listen teacher…	T
T12	…following teacher …	T
T13	…taking notes and listening lecture…	T

M= Modern belief; T= Traditional belief

4.2.4. Learning environment

The subsequent positive value of classroom environment in traditional belief category (Table 4.1) denoted that participants of the study did not support the contemporary classroom scenario rather a quiet and calm classroom state was appealing to perform whole class instruction and routine activities. In responding to the ideal setting of teaching during interview, nine (69.2%) of the participants' teachers supported the notion similar to those of traditional beliefs as shown in the table 4.5. On the other hand, four (30.8%) of the participants' belief regarding classroom organization analogous to modern setting where teachers offer a variety of avenues for exploration various routes of approaches and where unexpected classroom happening is anticipated by the teachers.

Table 4.5. Teacher's beliefs about learning environment

Teacher (T)	Summary of the interview excerpt	Category
T 1	…no specific setting, various ways of teaching…	M
T2	…calm and quite classroom conveying the knowledge…	T
T3	…various ways of teaching group/ peer work…	M
T4	…conducive environment instructing whole class…	T
T5	…noiseless atmosphere for instruction…	T
T6	…different ways of teaching; peer or group discussion…	M
T7	…conducive environment instructing whole class…	T
T8	…risk free environment for expressing ideas…	M
T9	…well managed classroom whole class instruction…	T
T10	…calm and quite classroom for lecture…	T
T11	…calm and quite classroom for lecture…	T
T12	…favorable environment to hear lecture…	T
T13	…calm and quite classroom to deliver lecture…	T

M= Modern belief; T= Traditional belief

4.2.5. Curriculum or learning content

The positive value (Table 4.1) in the traditional belief category regarding curriculum indicates that teacher participants comfortable with fixed and rigid curriculum which is seen as the list of things to be taught. The results of the survey were validated by the results of the interview. Ten **(77%)** of the interviewed participants' beliefs aligned with transmission view (Table 4.6) of the curriculum which means static; planned and well sequenced; a finite body of predetermined knowledge listed in the book to be covered. The reasons for choosing this static view as stated by the participants were shown in the table (Table 4.6).

In contrast, three **(23%)** out thirteen teacher participants' beliefs analogous to modern beliefs of the curriculum which is interactive and dynamic, focusing thinking and reasoning. Dynamic view of curriculum is like as matrix of ideas to be explored over a period of time than as road map which is relaxed and flexible in nature and focusing on thinking and understanding by problem solving or inquiry. During interview, the respondents were asked about reasons for teaching facts vs. development of thinking and reasoning, only three of them supported this notion of dynamic curriculum (Table 4.6).

Table 4.6. Teacher's beliefs about learning content

Teacher (T)	Summary of the interview excerpt	Category
T 1	…generating new ideas…	M
T2	…promoting next grade…	T
T3	…generating new ideas…	M
T4	…passing the exam…	T
T5	…completing syllabus, having good score…	T
T6	…expressing various ways…	M
T7	…completing syllabus exam…	T
T8	…passing exam, promotion…	T
T9	…cutting good score of science…	T
T10	…passing the exam…	T
T11	…passing and promoting to next grade…	T
T12	…covering syllabus…	T
T13	…cutting good score during the exam...	T

M= Modern belief; T= Traditional belief

Table 4.7. shows the summary of the interview findings. Around 54% of the interview respondents held modern beliefs regarding teaching strategies. Similar trends shows also in the case of teachers' role. Regarding student' role and learning content aspects 23% of the participants held modern beliefs while around 31% teachers support modern beliefs regarding learning environment.

Table 4.7. Summary of the interview findings with percentage (%) distribution of the modern (M) beliefs category.

Teacher (T)	Teaching aspects					
	Teaching strategy	Learning environment	Teachers' role	Best way of learning	Students' role	Learning content/ curriculum
T1	M	M	M	M	M	M
T2	T	T	T	T	T	T
T3	M	M	M	M	M	M
T4	T	T	T	T	T	T
T5	M	T	M	T	T	T
T6	M	M	M	M	M	M
T7	M	T	M	T	T	T
T8	M	M	M	M	T	T
T9	T	T	T	T	T	T
T10	M	T	M	T	T	T
T11	T	T	T	T	T	T
T12	T	T	T	T	T	T
T13	T	T	T	T	T	T
	53.8%(7)	30.8%(4)	53.8%(7)	30.8%(4)	23.0%(3)	23.0%(3)

*Figures in parentheses are in frequencies

4.3. Factors that influence teachers' beliefs

Table 4.8 shows that teacher' beliefs varying in terms of teaching experiences and in-services trainings but remained constant in terms of gender and disciplines. The participants of the study having teaching experience from 1st year to 10th years had traditional belief but those with experience ranging between 16 years to 20 years above, possessed contemporary beliefs. Participants having teaching experience from 10 to 15 years possessed inconsistent beliefs regarding various aspects of teaching and learning.

In-service training was found as an influential factor to teachers' beliefs. The participant of the study shown that the participants who received CPD, TQI, and OT trainings held contemporary beliefs whereas the participants with the training B.Ed. and SBC, possessed traditional beliefs in various aspect of teaching and learning.

Table 4.8. Ipsative mean score of teachers by gender, subjects, teaching experience and trainings

Background factors	Sub-category	Belief dimensions: Traditional beliefs on Teaching–learning aspects					Modern belief on Teaching-learning aspects				
		Teaching style	Teacher role	Student role	Learning environment	Curriculum/ learning content	Teaching style	Teacher role	Student role	Classroom environment	Learning content/ Curriculum/
Gender	Male	-0.12	-0.04	0.04	0.13	0.22	0.12	0.05	-0.04	-0.13	-0.22
	Female	-0.04	-0.02	0.04	0.09	0.18	0.03	0.02	-0.04	-0.09	-0.18
Subject taught	Physics	-0.08	-0.04	0.34	0.08	-0.15	0.08	0.04	-0.34	-0.08	0.15
	Chemistry	-0.09	-0.06	0.50	0.02	-0.19	0.09	0.06	-0.50	-0.02	0.19
	Biology	-0.250	-0.250	0.33	0.08	-0.33	0.25	0.25	-0.33	-0.08	0.33
Experience (Y)	First year	00	0.12	0.50	0.25	0.13	00	-0.13	-0.50	-0.25	-0.13
	1-2 years	0.16	0.06	0.03	0.16	0.13	0.16	-0.06	-0.03	-0.16	-0.13
	3-5years	0.11	0.15	0.33	0.11	0.17	0.11	-0.15	-0.33	-0.11	-0.17
	6-10 years	0.02	0.06	0.40	0.02	-0.12	-0.02	-0.06	-0.40	-0.02	0.12
	11-15 years	-0.05	-0.04	0.52	0.025	-0.12	0.05	0.04	-0.52	-0.02	0.13
	16-20 years	-0.16	-0.10	-0.55	-0.04	-0.19	0.16	0.10	0.55	0.04	0.19
	20 +	-0.20	-0.15	-0.53	-0.09	-0.36	0.20	0.15	0.53	0.08	0.36
In-service training	B.Ed.	0.09	0.33	0.12	0.08	0.12	-0.09	-0.33	-0.12	-0.08	-0.12
	SBC	0.15	0.41	0.30	0.156	0.13	-0.15	-0.41	-0.30	-0.16	-0.13
	CPD	-0.04	-0.02	0.04	-0.09	-0.18	0.04	0.02	-0.04	0.09	0.18
	TQI	-0.12	-0.04	0.04	-0.13	-0.22	0.12	-0.05	-0.04	0.13	0.22
	OT	-0.16	-0.10	0.55	-0.04	-0.19	0.16	0.10	-0.55	0.04	0.19

Note: *Positive score values indicate that one set of beliefs receives a relatively stronger support than other*.

Findings from the interview shown in Table 4.9 were parallel to this. It was found that participants with long teaching experience and much training hold modern beliefs. It was also found that B.Ed. training (the basic required training for secondary teachers) did not have influence in teacher's beliefs as like as gender. In this study, discipline or subject was not found as an influential agent in teaches' belief.

Table 4.9. Summary of the interview findings with background factors

Teacher	Background Factors								Beliefs on teaching-learning aspects					
	Gender (M/F)	Experience (Y)	*Subject taught	**In-service training					Teaching strategy	Learning environment	Teachers' role	Best way of learning	Students' role	Learning content/ Curriculum
				B.ED	SBC	TQI	CPD	OT						
T1	F	15	P	√	√	√			M	M	M	M	M	M
T2	M	2	B	√					T	T	T	T	T	T
T3	M	17	C	√	√	√	√	√	M	M	M	M	M	M
T4	F	6	C	√					T	T	T	T	T	T
T5	M	10	B	√	√	√			M	T	M	T	T	T
T6	F	14	B	√	√	√	√	√	M	M	M	M	M	M
T7	M	9	B	√	√				M	T	M	T	T	T
T8	M	12	C	√	√	√			M	M	M	M	T	T
T9	M	6	P	√	√				T	T	T	T	T	T
T10	M	11	C	√	√	√			M	T	M	T	T	T
11	M	7	B	√	√				T	T	T	T	T	T
12	F	5	C	√					T	T	T	T	T	T
13	M	8	C	√	√				T	T	T	T	T	T

*P, Physic; C, Chemistry; B, Biology ** B.Ed., Bachelor of Education, TQI, Teaching Quality Improvement; SBC, Subject Based Cluster , CPD, Continuing Professional Development; OT, 3 Month Overseas Training

4.4. Part II: Results about the teaching practices and the factors influence teaching

The following sections explain the results about teaching practices in terms of teacher-student interaction; nature of teachers' questions; nature of students' responses; the nature of teachers' feedback to students various responses as well as the pattern of discourse. In addition to that systematic classroom observation results about teaching also explain. In order to clarify the results especially about the feedback and the discourses, real excerpt of the lesson transcript was quoted.

4.4.1. Results regarding teacher-student interaction

Table 4.10 summarizes the frequency distribution of teacher-student talk in 14 science lessons. It shows that the category five (5) which is lecturing is the most prevalent with the frequency of 1782. The category four (4) which is asking question is also found predominant with the frequency of 617. The frequency of teacher initiation (3357) which is the combination of the categories 4, 5, 6, & 7 were found 15 times more than they response (199), the combination of the category 1, 2, & 3. The frequency of the student talk-initiation is rare with the frequency of 28. Students are often response to teacher questions which is very high with the frequency of 495. The category one (1) which is 'accept feeling' is almost absents with the frequency of 1 out the total the frequency of 3865.

Table 4.10. Frequency distribution of teacher-student interaction by lesson

Speaker		Category code*	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	Total	
			Lesson(L)															
Teacher talk	TR	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	199
		2	11	5	7	18	19	33	36	12	7	12	10	5	14	10	194	
		3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4	
	TI	4	60	48	50	45	53	26	40	48	41	36	44	44	36	46	617	3357
		5	112	136	131	102	160	133	134	120	118	115	137	152	139	113	1782	
		6	45	35	24	15	45	24	28	32	20	35	34	30	23	35	463	
		7	2	6	6	9	18	1	11	7	14	19	5	6	30	2	137	
Student talk	SR	8	45	36	41	40	44	15	35	36	36	32	35	37	25	38	495	
	SI	9	0	3	6	4	0	2	5	0	0	1	2	3	0	0	28	
Silence		10	13	13	1	10	17	5	8	10	11	14	9	12	9	12	156	
Total			288	282	266	247	356	239	298	265	265	264	276	289	262	256	3865	

*1=Accept feelings, 2=Praises or Encourages, 3= Accept or uses ideas of pupils, 4= Ask questions, 5= Lecturing, 6= Giving directions, 7= Criticizing or justifying authority, 8=Student talk-response, 9= Student talk- initiation, and 10= No student response or silence

Figure 4.1 summarizes the percent distributions of teacher-student talk under the ten categories suggested by Flanders. It is found that 77.2% of science talk covered by teachers' initiation which includes teachers' lectures, teachers' questions, teacher' directions and justifying authority (Fig. 4.1). Students' talk limited with students' responses to teachers' questions which were 13%. Student talk-initiation-a crucial part of student–centered teaching which allow student to express their ideas and make them empowered to be the part of knowledge construction- is almost absent which was accounted for 0.7%. Teacher talk response which is very rare accounted for 5.12%. Altogether 82.3% of classroom discourse covered by the teacher while student contribution only 13.7%.

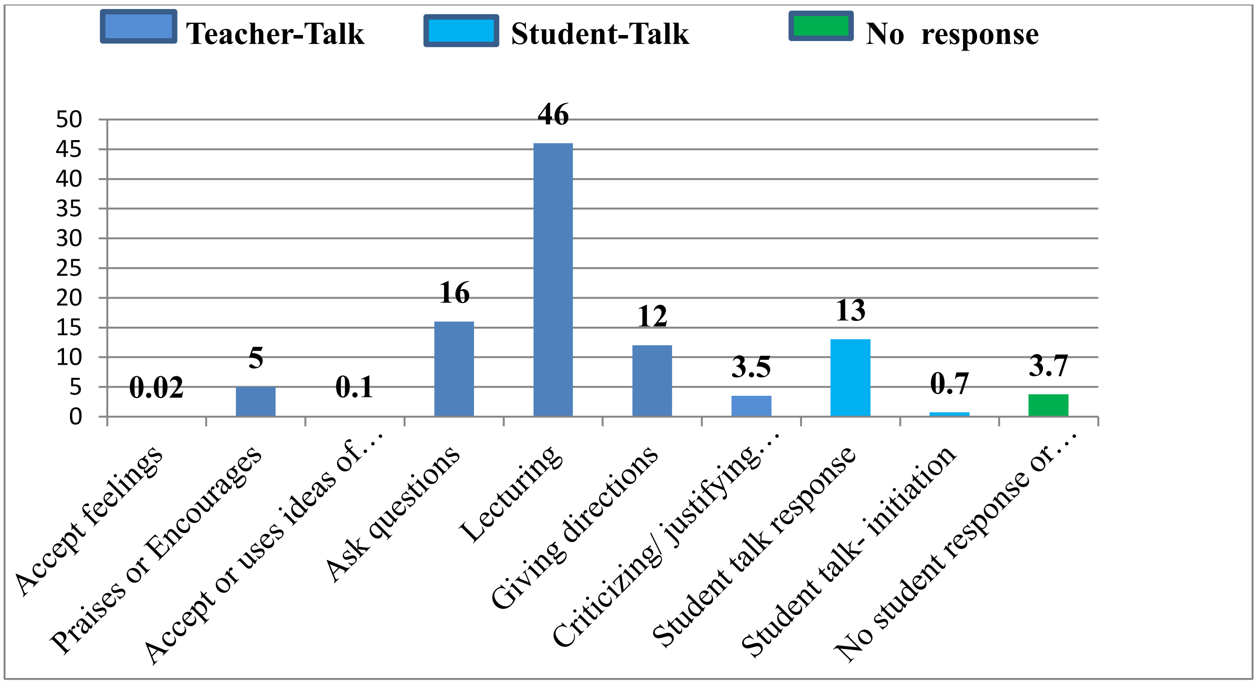

Figure 4.1. Percentage distribution of Teacher-student talk

4.4.2. Nature of teachers' questions

Table 4.11 summarizes the distributions and frequencies of the various types of teacher's questions. Altogether, 617 teachers' questions in different science lessons were identified in various questioning subcategories.

The most prevalent type of questions asked during class sessions at secondary level science was the question which checks students' *content knowledge* with a frequency of 174 (28.2%). Seconded by the *management strategy* question with a frequency of 145 (23.5%) followed by the question that representing something by a *word or phrase* with a frequency of 117 (19%) and *rhetorical* question with a frequency of 107 (17.34%). The questions assessing students ability to *analyze*, *evaluate* and *synthesis* of knowledge were with the frequencies of 8 (1.3%), 6 (0.97%) and 4 (0.65%) respectively. *Eliciting* pre-conceptions, *challenging* students to resolve and reviews inconsistent ideas, *extending* to construct new ideas from existing knowledge and assess students' *ability to use* those questions were found with the frequencies of 14 (2.3%), 5 (0.8%) 16 (2.60%) and 4 (0.65%) respectively.

Table 4.11. Frequencies of different types of teacher's questions in various science lessons

Lesson topics	Rhetorical question	Management strategy questions	Lower-order							Higher order				Conceptual change			Total
			Meaning	Read, draw, label	Content knowledge	Predictable answer	Definition and example	Word /phrase	Understanding	Analyze	Evaluate	synthesis	Eliciting	Challenging	Extending	Using /applying	
Motion	7	14			11			6			2	2	1	2	4	1	50
Living organism & their environment	12	13			12		1	10									48
Gas law	10	13		1	16		2	11	2	1			1		2	1	60
State of matter	5	7			8				1	2	2	2	6	3	8	1	45
Chemical reaction & equation	9	16		2	14			12									53
Plants classification	4	10			15			5					2				36
Virus	4	7	1		14		3	5		2			2		1	1	40
Human body	9	11			13			12			2				1		48
Periodic Table	8	10		1	12			7		2			1				41
Work, power & energy	6	10			3			7									26
Solution	8	10			12	1		11		1			1				44
Animal kingdom	7	6			16			13	2								44
Symbol, Formula & Valences	11	8			10			7									36
Structure of Matter	7	10			18			11									46
Total	107 (17.34)	145 (23.5)	1	4 (0.65)	174 (28.2)	1	6 (0.97)	117 (19)	5 (0.8)	8 (1.3)	6	4	14 (2.3)	5	16 (2.6)	4	617

*Figures in parentheses are in percentages

Figure 4.2 shows the percent distribution of major questioning categories. It is found that 50% of the teachers' questions were pitched under lower-order category. Percent distribution of rhetorical question (17%) and classroom management question (23.5%) were found also predominant. Conceptual-change questions and higher-order question were found in poor percentage distribution accounted for 6.3% and 3% respectively.

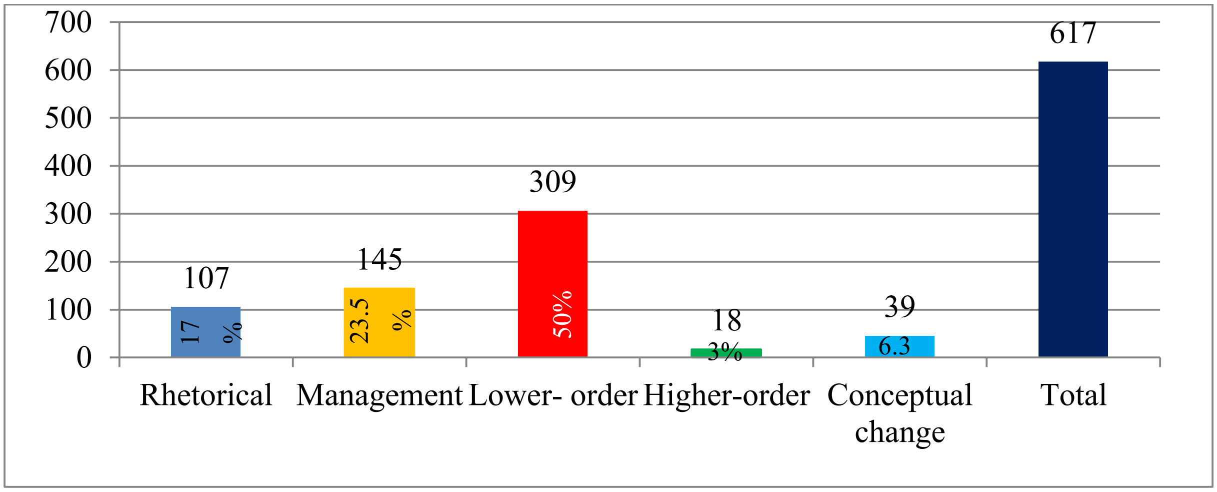

Figure 4.2. Percentage distribution of major questions categories in various science lessons

Rhetorical question (107) and the question that ask for classroom management (145), did not elicit higher cognitive levels of students' thinking, jointly accounted for 40.5% of the total questions. Excluding these two groups of questions, 368 questions were included in the data analysis for cognitive levels of teachers' questions. Figure 4.3 summarizes the question in the cognitive levels. It is indicated that among the cognitive level questions, 309 out of 365 questions were pitched at lower order cognitive level. It was accounted for 84.3% of the total questions asked during class discussion. Conceptual-change question has low frequency of 39 (10.7%) while higher order question rated as the lowest with the frequency of 18 (5%).

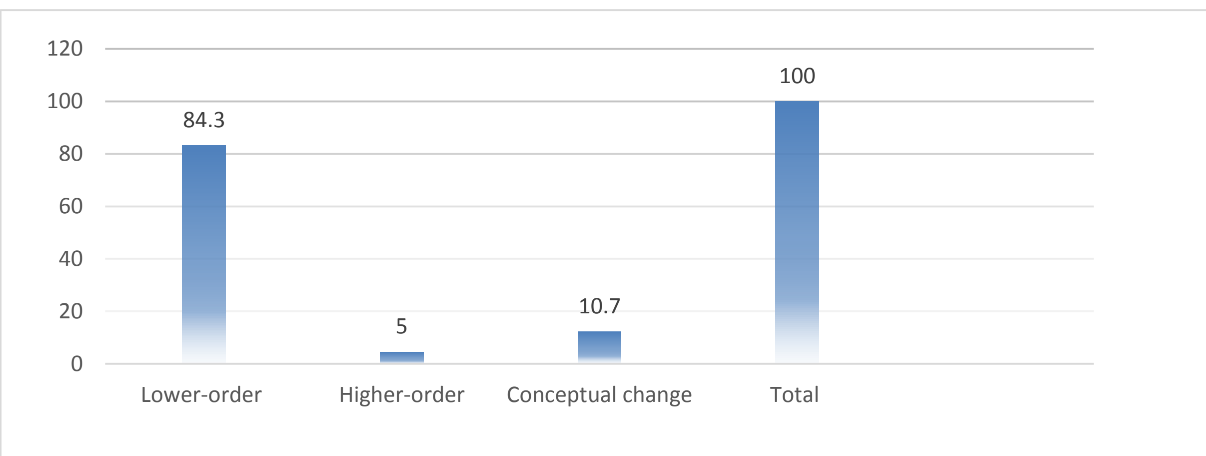

Figure 4.3. Percentage distribution of cognitive questions categories

4.4.3. Nature of student responses

Table 4.12 summarizes the distributions and frequencies of the various types of student's responses. Altogether, 495 student's responses in different science lessons were identified in various responses categories.

The most prevalent type of response evolves during class sessions at secondary level science was the *word* or *phrase* type with a frequency of 243. It was accounted for 49.7% of total responses evolved during classroom discussion. The second prevalent type of students' response was *no response* type with a frequency of 154 which was accounted for 31%. The long unreasoned response was found low with a frequency of 59 (11.9%) while *long reasoned response* was found very low with a frequency of 11 which was accounted for 2%. Other responses which were not discussed in this dissertation but revealed in this study were incomplete (2%), incorrect (1%), and I can't (2.4%) response.

An incomplete response is a response to a question that is not complete; or a response to a question that is interrupted by the teacher. An incorrect answer is a wrong response to a question or a response that is generally not true and unacceptable and finally I can't response is when a student utters "I can't" in response to a question.

Table 4.12. Frequencies of different types of students' responses in various science lessons

Lesson topics	Type of students' responses							Total
	Long response express thinking	Long response express knowledge	Incomplete response	Incorrect response	Word/ Phrase	I can't, I don't response	No response	
	CAR	CA	INC	ICR	W/P	ICN	NR	
Motion	2	8	1	1	14	1	13	40
Gas law	1	6	2	1	22		13	45
State of matter	3	11	2	1	16	2	6	41
Virus	3	6	2	1	13	2	8	35
Plants classification		4	1		14		13	32
Human body		4			19	3	10	36
Periodic Table	1	5			20		10	36
Solution	1	5	3	1	12	4	12	38
Living organism & their environment		2			20		14	36
Chemical reaction & equation		3			24		17	44
Work, power & energy		0			10		5	15
Animal kingdom		2			22		13	37
Symbol, Formula & Valences		2			14		9	25
Structure of Matter		1			23		11	35
Total	11(2)	59 (11.9)	11	5(1)	243 (49.7)	12(2.4)	154 (31)	495

*Figures in parentheses are in percentages

4.4.4. Nature of teachers' feedback

Altogether 495 teachers' feedback in different science lessons were found in various feedback categories. Table 4.13 summarizes the distribution and frequencies of the various types of teachers' feedback. Analysis of the results regarding feedback organized by its types and illustrates with the examples selected from real lessons excerpt.

4.4.4.1. Types of feedback to students' correct or partial correct responses

Among the science lessons analyzed, four types of feedbacks were found in the case of students' correct or partial correct responses. The most common and predominant type of feedback is '*restating student correct answer-direct instruction*' (C-S). It was accounted for 36% (Table 4.13). The following excerpt illustrates an example where teacher restate student's correct answer and then moved on to talk about further scientific information via direct instruction. This type of feedback has a transmitting function as well as authoritative nature. With a similar notion, Scott (1998) states that paraphrasing student responses is the highest level of teacher control and thus treated as evaluative type feedback.

> *Teacher*: How many molecules that scientist has discovered in nature and in chemical laboratory?
> *Student*: one hundred and eighteen.
> *Teacher*: 118 molecules. Scientist has discovered 118 molecules both in nature and in chemical laboratory. If we want to know about all 118 molecules individually, is it possible? It is not possible or quite tough for us to learn their characteristics separately.
> *(Taken from grade nine chemistry, chapter-Periodic table)*

The second prevalent type of feedback was found '*neutral comment-asking question'* (C-Q1). Among the feedbacks it was accounted for 23.8% (Table 4.13). In this case, teacher accepts student responses in a neutral manner, affirm the response with a comment such as, Yes, Okay, hum, or occasionally restating student's responses. This was followed by a question. Through this type of feedback, teacher was tried to extend student's thinking as well as involving student into prolonged discussion. Following excerpt is an illustration of this type of feedback.

> *Teacher*: When Candle burns, what kinds of changes will you expect to occur?
> You (indicating one S) Tell.
> *Student* 1: Chemical change *(Partial correct)*
> *Teacher*: hum! What Else?
> *Student* 1: Chemical change and ……. I can't sir
> *Student2*: Physical change too.
> Teacher: S1 and S2 said physical and chemical change, do you agree with them?
> *Students*: Yes (in chorus)
> *Teacher*: so chemical and physical change occur during candle burning. *(Taken from grade nine chemistry, chapter-State of Matter)*

The feedback type '*precise question for elaboration'* (Q1) and '*ask student to judge'* (Q2) were found less frequent by 1.6% and 1.2% respectively of the lessons analyzed (Table 4.13). Through precise question, teacher tries to probe further student knowledge in conceptual level. The following excerpt illustrates *precise question* type feedback.

> *Teacher*: what we write instead of Carbon dioxide?
> *Student*: CO2

Teacher: what does CO_2 have?
Student: Carbon, Oxygen
Teacher: Carbon, Oxygen, so we have carbon and oxygen in CO_2. *(Taken from grade eight general science, chapter-Chemical reaction and equation)*

Through feedback '*asking student to judge*' teacher guides the entire class towards the scientific concept. Teacher remains neutral as well as shifting authority for evaluating answer from teacher to all students. Following excerpt, *taken from grade nine chemistry, chapter-State of matter,* is an illustration of the above type.

Teacher: Any one?
Student2: water.
Teacher: S1 and S2 said that it produces CO_2 and water, are these final? Do you agree with them?
Students: Yes sir (in chorus)
Teacher: so, water and Carbon dioxide.

4.4.4.2. Types of feedback to students' incorrect or no responses

By analyzing various science lessons in different grades in secondary level, five types of feedbacks were found in the case of students' incorrect or no responses. Among which, '*explicit correction-direction instruction*' (S-Q) was found predominate. It was accounted for 18% (Table 4.13). In this case, teacher overtly pointing out the student's mistake by saying 'no', 'your answer is wrong', that's not the right answer'. After point out the student's mistake, the teacher proceeded to give the correct answer and then carried on with telling them more scientific knowledge via clear exposition. After giving more content knowledge, teacher asked an instructional question. Following excerpt is an example of this type of feedback.

Teacher: Is there any difference between DNA and RNA?
Student: No Sir (incorrect answer)
Teacher: No no! There are differences. DNA is Double standard but RNA is Single standard not only that the sugar molecule of both nucleic acid is different. Nucleic acid is the main component of the virus by which it can infect other plants or animals and cause disease. There are many plants and animals diseases caused by virus. Plant diseases like tobacco mosaic disease, bean mosaic diseases, tomato vein cleaning disease, etc. Influenza, small fox, ham, etc., are some of the example of human diseases. Beside human being virus causes many diseases in animals. Cowpox, Ranked, Parrot fever, etc. There is no medicine for viral diseases. So we have to be very careful about virus. *How do viruses spread in the environment?* (*Taken from grade nine, Biology, topic-virus*).

In case of incorrect response, the second prevalent type of feedback was found '*no comment-direct instruction* (S)'. Among the feedback it was accounted for 12.7%. The teacher's feedback was in the form direct instruction followed by a series of statements. Following excerpt is an illustration of the kind mentioned above taken from grade eight general sciences, chapter -*Living organism & their environment*.

Teacher: Like mesophytes, plants those grow in water they have a name? Do you know the name?
Student: no response

Teacher: Such aquatic plants grow abundantly in rivers, canals, lake, ditches, ponds, and other aquatic habitats. Plants which grow in water or place of having water are known as hydrophytes.

The feedback in the form of *'restate the question along with comment'* (C-Q2); '*constructive challenge*' (Q3); and '*response give back to the student via question'* (Q4) did not have much or very negligible room in the case of incorrect or no response dimension in various science lessons studied. They were accounted for 3 %, 1.6% and 1.8% respectively (Table 4.13).

In the case of C-Q2 form of feedback, teacher kept neutral without articulating student's mistake explicitly. Instead, teacher restated or reformulated her question in the form of recast as a non-threatening manner. This type of feedback ensures inquiry atmosphere and results normal classroom discussion (Goodrum, 2004). The following excerpt is an illustration of this kind of feedback taken from grade *nine chemistry, chapter-state of matter*.

Teacher: hum! What is called this phenomenon?
Student1: No response
Teacher: Ok! $CuSO_4$ mix with water, there is a scientific phenomenon. So what is called that phenomenon?
Student1: It is called… it is called…

The feedback in the form of *constructive challenge*, teacher remained neutral but challenged student by posing another question in the case of incorrect student's response. The intension of asking this type of question is to force the student to reflect on and reconsider the answer made earlier (Chin, 2006). The following excerpt is an illustration of this kind of feedback taken from grade *nine chemistry, chapter-Symbol, Formula and valences*

Teacher: (ask the example of compound matter) you? Tell
Student: Aluminum, (*incorrect answer*)
Teacher: why do you call Aluminum is a compound matter? What is the component of Aluminum?
Student: No response
Teacher: if aluminum is chemically analyzed, what do we get?

The feedback in the form of *response give back to the student via question*, known as "reflective toss" (van Zee & Minstrell, 1997a), in this case, teacher remained neutral followed by a question build on student's previous response, thereby throwing the responsibility to think back to student to judge the response made earlier. The purpose of this type of feedback is to move forward learner toward self-directing learning, one of the characteristics of effective learning (Griffin, 2006). The following excerpt is an illustration of this kind of feedback taken from grade *nine chemistry, chapter-state of matter*.

Student1: it is called ….
Student2. It is called effusion (*Scientifically incorrect answer*)
Teacher: Is this effusion? Why did you think so?
Student2: no sir, this is called diffusion (*self-correction*)
Teacher: yes! this is called diffusion. You have seen that $CuSO_4$ has spread to the whole water. Some of you have shaken it. *What happened when you have shaken the tube?*

Table 4.13. Frequencies of different types of teacher's feedback in various science lessons

Lesson topics	Types of Teacher feedback									Total
	Correct / partial correct response				incorrect /No response					
	Restate student response-direct instruction	Neutral comment-asking question	Precise question for elaboration	Ask student to judge	Explicitly correction-direction instruction	No-comment direct instruction	Restate the question along with comment	Constructive challeng	Reponses give back t student	
	C-S	C-Q1	Q1	Q2	S-Q	S	C-Q2	Q3	Q4	
Motion	17	9	3	1	5	3	1	2	4	45
Gas law	10	14			7	4	2	2	1	40
State of matter	9	15	2	3	2	1	4	2	3	41
Virus	12	14	1		3	2	2	1		35
Plants classification	11	9	2	2	5	2	1			32
Human body	11	6			8	10		1		36
Periodic Table	12	11			7	3	2		1	36
Solution	13	10			5	4	3			35
Chemical reaction & equation	17	4			9	6				36
Living organism & their environment	16	11			10	7				44
Work, power & energy	5	4			2	4				15
Animal kingdom	18	4			8	7				37
Symbol, Formula & Valences	9	3			9	4				25
Structure of Matter	18	4			10	6				38
Total	178 (36%)	118 (23.8%)	8 (1.6%)	6 (1.2%)	90 (18%)	63 (12.7%)	15 (3%)	8 (1.6%)	9 (1.8 %)	495

*Figures in parentheses are in percentages

Table 4.14 summarizes the feedback by its type and by responses. It shows that 67% of teachers' feedback was evaluative and corrective type while 33% belongs to neutral/ facilitative type to students' correct, partial correct, incorrect or no responses.

It also reveals that teachers employed more feedback to student's correct or partial correct response which was accounted for 63%. Higher percent feedback towards correct or partial correct responses is an indication that teachers like more students' correct responses rather than incorrect or no responses.

Table 4.14. Frequency distribution of feedback by response

Feedback type	Response type		Total (N)
	Correct/ partial correct	Incorrect/ No response	
Evaluative/ corrective	178	153	331(67)
Neutral/ facilitative	132	32	164(33)
Total	310(63)	185(37)	495

*Figures in parentheses are in percentages

Feedback is the ultimate determinants of the nature of classroom discourse. Classroom talk or discourse can be dialogue or monologue completely depends on the feedback teacher's employ to students' correct, partial correct, incorrect or no responses. The flowing section explains about the pattern of discourse.

4.4.5. Pattern of discourse

Table 4.15 shows an example of two kind of discourse. It shows that how the feedback changes the discourse flow and turns it into dialogue or monologue. In order to identify the pattern of discourse, this study considers the characteristics of the talk and the flow of talk. Type 1 discourse where the feedback is evaluative has its some unique characteristics: teachers asked closes questions, student response remain detached or word or phrase type; only single student participate in the talk; and the flow of talk instinctively got shape three steps-Teacher question-student response- teacher evaluation (IRE) (Fig. 4.4); and teacher hold authority to judge. Around 67 % of talk holds this type of characters called monologue or authoritative talk.

Table 4.15. Excerpt of real lesson based on feedback

Pattern of discourse	
Type 1 (Evaluative feedback)	Type2(Neutral feedback)
Teacher: Plants which grow in water or place of having water are known as hydrophytes. These plants have some characteristic. What are those characteristics? You tell me one character? *Student*: maybe they don't have root *(incorrect response).* *Teacher*: No! They have root but the roots are very short, don't have root cap. What other characters? What about their stem? *Student*: no response *Teacher*: their stems are very soft. The laves of the floating plants are large, round, and with long petioles. Why are you talking? Don't talk. So how do their leaves look like? *Student*: large and round *Teacher*: large and round, good (Loud voice), what is their petiole? *Student*: petiole is long *Teacher*: very good! The upper surface of the leaves is provided with a waxy coating. Flower of floating plants are bright. What other characters?	*Teacher*: What will happen inside the test-tube if you mix CuSo4 with water? *Student*: When we mix $CuSO_4$ to water it will make a complete solution. *Teacher*: hum! What is called these phenomena? *Student1*: No response *Teacher*: CuSO4 mix with water, there is a scientific phenomenon. So what is called this phenomenon? *Student1*: it is called …. *Student2. It is called effusion(Scientifically incorrect response)* *Teacher*: Is this effusion? Why did you think so? *Student2*: no sir, this is called diffusion (*self-correction*) because there is no hole. *Student1*: yes sir, it is called diffusion *Teacher*: Do you agree with them (S2 & S1)? *Students*: Yes sir (chorus) *Teacher*: YES! This is called diffusion. You have seen that $CuSO_4$ has spread to the whole water. Some of you have shaken it. *What happened when you have shaken the tube?*

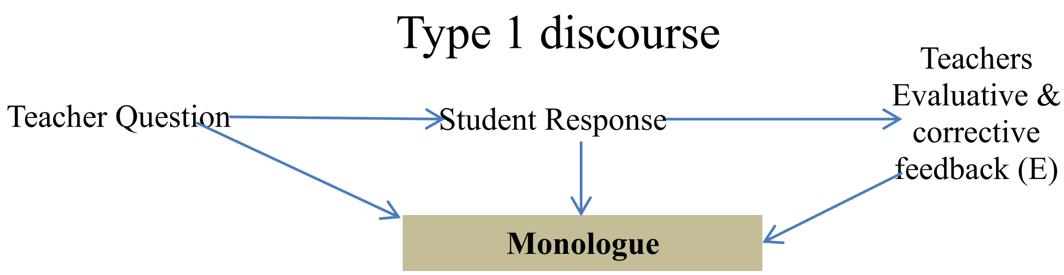

Figure 4.4. Flow of monologic/ authoritative talk

On the other hand, type 2 discourse where feedback is neutral possessed some unique characteristics: teacher asked open question; student response similar to sentence/s; more than one student participated in the discussion; the flow of talk has more than three step: teacher question- student answer-teacher neutral feedback-student response-teacher evaluation remarks (IRFRF…) (Fig, 4.5); and teachers shift authority to student to judge. Around 33% of talk holds this character called dialogue/dialogic talk.

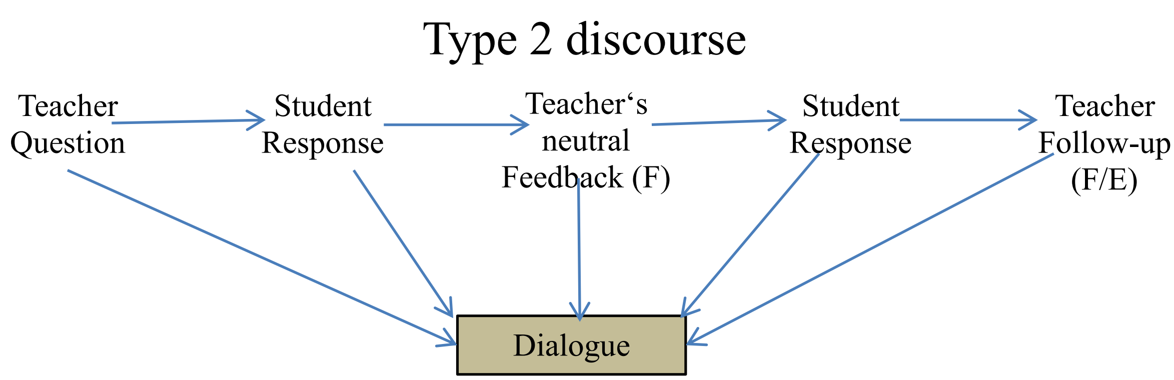

Figure 4.5. Flow of dialogic discourse

4.4.6. Results regarding direct classroom observation

Table 4.16 summarizes the results of the direct classroom observations. It shows that structure-oriented practice was found most prevalent. Student-oriented practice was very rare while enhance activities were totally absent.

Results indicate that secondary science teachers of Bangladesh are comfortable in structure-oriented teaching practices which correspond to didactic teaching. The practice includes learning goal, review student homework, present short summary of the previous lesson, check students exercise book, giving lecture and checking by asking question whether the lesson content is understood or not.

In the structure-oriented practice, reviewing student homework (RSH) and lecturing and checking by asking question (L & C) whether the lesson content is understood or not were found predominant. This findings agree with video analysis lesson by using Flanders (1970) and Chin (2006, 2007) methods.

Only two lessons were found practicing student oriented activities limited to working in group (WG) and helping in lesson activities (HPCAT).

Table 4.16. Summary of the direct classroom observation by lessons

Lesson topics	Structure-oriented practice					Student-oriented practice			Enhanced activities			
	SLG	RSH	PS	CSEB	L&C	WG	HPCAT	EROW	WP	SMP	WE	HD
Motion	×	×	×	-	×	-	-	-	-	-	-	-
Living organism & their environment	×	×	×	×	×	-	-	-	-	-	-	-
Gas law	-	×	-	×	×	×	×	-	-	-	-	-
State of matter	×	×	×	-	×	-	-	-	-	-	-	-
Chemical reaction & equation	-	×	×	×	×							
Plants classification	-	×	-	×	×	-	-	-	-	-	-	-
Virus	×	×	×	-	×	×		-	-	-	-	-
Human body	-	×	×	-	×	-	-	-	-	-	-	-
Periodic Table	-	×	×	×	×	-	-	-	-	-	-	-
Work, power & energy	×	×	-	×	×	-	-	-	-	-	-	-
Solution	-	×	×	-	×							
Animal kingdom	-	×	×	×	×							
Symbol, Formula & Valences	×	×	×	×	×							
Structure of Matter	×	×	×	×	×							

"×"= indicates observed; "-"= indicates not observed

Legends: SLG=State learning goals; RSH= Review students' homework they have prepared; PS= present a short summary of the previous lesson; CSEB= Check students' exercise books; L & C= Lecture and check by asking questions; WG= working in group; HPCAT= help in lesson and activity; EROW= Evaluate and reflect their work; WP= work on project; SMP= Student make product; WE= writing essay; HD= hold a debate

4.6. Factors that influence teaching practices

Table 4.17 shows the frequencies of the questions under major categories along with teachers' background factors.

It explains that teachers' questioning differs in terms of teaching experiences and in-service trainings. The teachers whose teaching experience is ranging between ten to seventeen years, asked higher order and conceptual change questions along with other question categories. On the other hand, those teaching experience were in between two to eight years, asked basically lower order questions.

In-service training was found influential to teachers' questioning. The teacher of the study showed that who received TQI, CPD and short term OT asked higher order and conceptual-change question. Among the in-service trainings, TQI training was found the most influential regarding teachers' questioning. However, teachers who received B.Ed. and SBC, asked lower order question along with rhetorical and management strategies questions. Gender and subject taught at graduation level did not exert influence on teachers questioning in this study.

Table 4.17. Summary of the teachers' questions along with background factors

Teacher	Gender M/F	Experience (Y)	*Subject taught	**In-service training					Major questioning categories					
				B.ED	SBC	TQI	CPD	OT	Rhetorical	Management	Lower order	Higher-order	Conceptual change	Total (n)
T1	F	15	P	√	√	√			7	14	17	4	8	50
T2	M	2	B	√					12	13	23			48
T3	M	17	C	√	√	√	√	√	10	13	32	1	4	60
									5	7	9	8	18	45
T4	F	6	C	√					9	16	28			53
T5	M	9	B	√	√	√			4	10	20		2	36
T6	F	14	B	√	√	√	√	√	4	7	23	2	4	40
T7	M	10	B	√	√				9	11	25	2	1	48
T8	M	12	C	√	√	√			8	10	20	2	1	41
T9	M	6	P	√	√				6	10	10			26
T10	M	11	C	√	√	√			8	10	24	1	1	44
T11	M	7	B	√	√				7	6	31			44
T12	F	5	C	√					11	8	17			36
T13	M	8	C	√	√				7	10	29			46

*P, Physic; C, Chemistry; B, Biology ** B.Ed., Bachelor of Education, TQI, Teaching Quality Improvement; SBC, Subject Based Cluster, CPD, Continuing Professional Development; OT, 3 Month Overseas Training

4.5. Part III: Results regarding relationship between beliefs and practice

According to the summary of the teachers beliefs (Table 4.7) science teachers of the researched secondary schools were grouped accordingly: Traditional, Transitional, and Modern.

a) Traditional beliefs regarding teaching-learning

Science teachers in this group believe in ***transmission of knowledge*** to student by teacher or other credible sources. They do not consider students as active constructor of knowledge and think that they are the ***recipient of knowledge*** and followers of the teachers as ***passive learners***. They do not believe in dynamic view of classroom environment rather believe in a calm and quite situation in order to ***deliver lecture*** and *doing routine works*. They focus on ***covering syllabus*** or *passing* exam or *promoting* next level rather than thinking and reasoning.

b) Transitional belief about teaching-learning.

Science teachers in this group show ***inconsistencies*** in expressing their beliefs on teaching-learning. For example, a teacher may state the role of the teacher as facilitator but he does not believe in student's active role in knowledge construction. The same teacher believes in covering syllabus without considering learners' thinking and reasoning toward conceptual development. Some of them believe in interaction through discussion.

c) Modern beliefs about teaching-learning

Science teacher in this group have a strong understanding about modern principles of teaching and learning. They believe the importance of learner's ***self-responsibility*** in the process of learning where they ***involve actively*** constructing their knowledge through ***variety of teaching activities***. They state the role of the teacher as a ***guide or helper to support student's learning***. They believe in the necessity of dynamic or a relaxed classroom environment where students express or share their ideas without fear. Equally, they are aware of the ***group work and interaction among*** students in knowledge construction. Fig 4.6 shows the distribution of science teachers' beliefs based on the criteria described above.

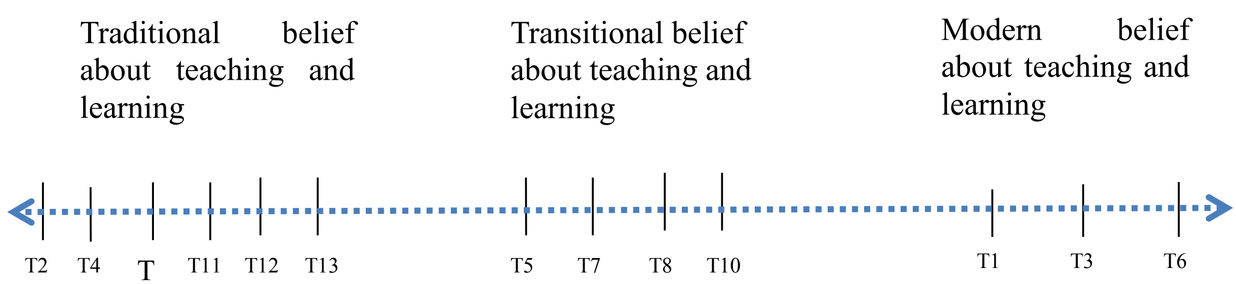

Figure 4.6. Distribution of science teachers' beliefs about teaching-learning

The following section of the results will explain the relationship between beliefs and practices. The explanation will base on the basis of interaction, nature of teachers question, nature of students response and the nature of feedback. Finally, relationship between beliefs and practices will be searched on the basis of direct classroom observation.

4.5.1. Teacher-student interaction

Figure 4.7 shows the frequency distribution of teacher-student interaction by teacher's category.

Compare to traditional and transitional group of teachers, *modern teachers* did not dominate their classroom through lecturing only. Besides, they praise students and use students' ideas and ask more questions. Giving direction and justifying authority was found least prevalent compare to other teachers group. They allowed students to talk and express their ideas (Fig.4.7). Through the diversify discourse activities, they tried to support students learning and engage them into learning process which is consistent with their beliefs.

Transition teachers moderately use lecturing in their classroom talk (Fig.4.7). Besides, they praise students and accept students' feeling and ask questions. The categories giving direction and justifying authority was found moderately. They also allow students to talk and expressed their ideas. They tried to support students' learning by accepting their feeling and praising their ideas but at the same time they did not believe in using students' ideas to develop lesson thus, show inconsistency in beliefs and practices.

Traditional teacher dominated their classroom talk through lecturing and asking many questions (Fig.4.7). Apart from "praising" using students' idea and accept student feeling were totally absent. The categories giving direction, and justifying authority was found predominantly. No response category was found also in high frequency. The category 'student talk-initiation' was absolutely absent. Through predominant lecturing they attempt to transfer knowledge, did not allow student to express their feeling. By lecturing they ultimately covered prescribed syllabus as well as transmitted precise knowledge to their student. Since there is no student activity, they are recognized as passive recipient of the true knowledge. Thus, teachers in this group show the consistency between their beliefs and actions.

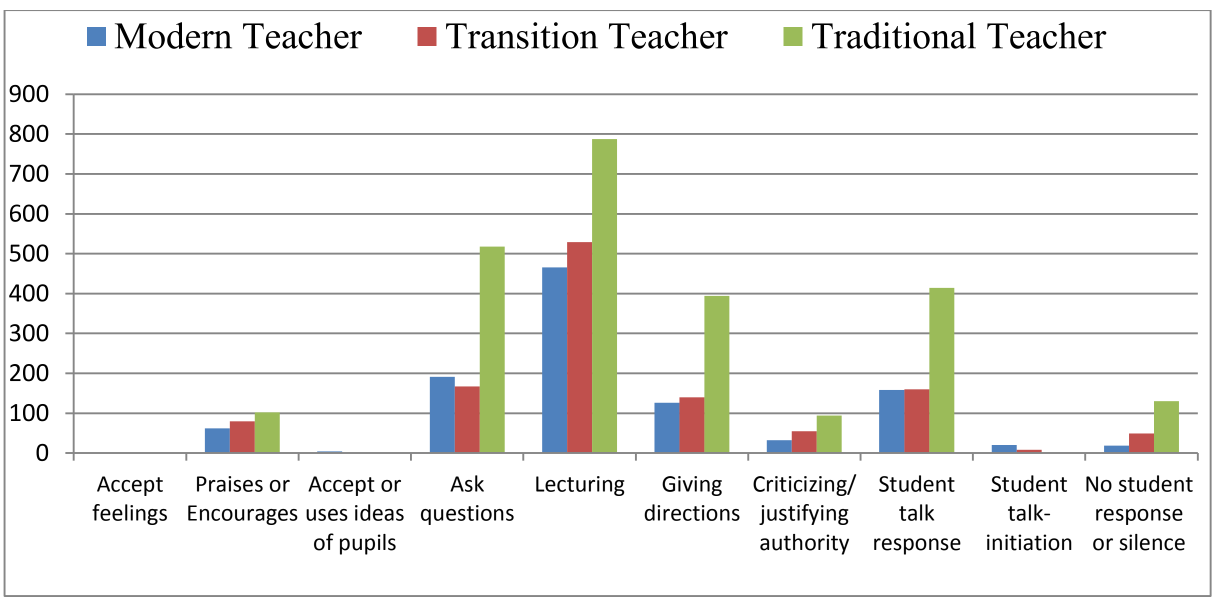

Figure 4.7. Frequency distribution of teacher-student talks by teacher category

4.5.2. Teachers question

Table 4.18 summarizes the distribution and frequencies of questions by teachers' categories. It shows that science teachers under modern group asked almost all kind of questions. They had very rich collection of questions. Along with lower-order questions, they asked a good number of analyzing, evaluating and synthesis type question with the frequency of 5, 4, and 4 respectively. The number of conceptual type questions under the subcategories namely eliciting, challenging, extending and using were found quite good in number with the frequency of 10, 5, 15, and 4 respectively. By asking various types of questions under different cognitive level, science teachers of the modern group tried to engage the students into the lesson in multiple ways. It is said that to enable students a wide range of thought process effective teachers use variety of questions (Ewing & Whittington, 2007). Since their espoused beliefs were to engage students actively, hence, they show the regularity with their enacted beliefs.

Science teachers under transitional group had poor collection of questions. Beside lower- order questions, they asked analyzing and evaluative type questions with the frequency of 3 and 2 respectively. Under conceptual-change type questions they asked only eliciting and extending type of questions with the frequency of 4 and 1 respectively. But no challenging and using or applying type questions were found. Teachers of this group tried to engage learners cognitively by asking higher order and conceptual-change type questions but at the same time, they tried to disengage them through asking high number of lower-order questions this action is parallel to their beliefs.

Science teachers under traditional group had very poor repertoire of questions (Table 4.18). All most all the question they asked were under the subcategory of assessing student content knowledge with frequency of 73 and the question that representing something word or phrase with the frequency of 60 under lower-order category. In addition to that, a high number of rhetorical and management strategy question were found to be asked with the frequency of 52 and 63 respectively. There was no place for higher-order and conceptual-change type questions. Teachers under this group did not create students' cognitive dissonance as well as they did not challenge students since there is no higher-order and conceptual change questions. As a result, students did not actively participate in the lessons. Therefore, they treated the learners as the passive recipient of knowledge which is parallel to their beliefs.

Table 4.18. Frequencies of different types of questions by teachers' category

Category	Teacher(T)	Rhetorical question	Management strategy questions	Lower-order							Higher order				Conceptual change			Total
				Meaning	Read, draw, label	Content knowledge	Predictable answer	Definition and example	Word /phrase	Understanding	Analyze	Evaluate	synthesis	Eliciting	Challenging	Extending	Using /application	
Modern Teacher	T1	7	14			11			6			2	2	1	2	4	1	50
	T3	10	13		1	16		2	11	2	1			1		2	1	60
	T3	5	7			8				1	2	2	2	6	3	8	1	45
	T6	4	7	1		14		3	5		2			2		1	1	40
	Total	26	41	1	1	49	0	5	22	3	5	4	4	10	5	15	4	195
Transitional Teacher	T5	4	10			15			5					2				36
	T7	9	11			13			12			2				1		48
	T8	8	10		1	12			7		2			1				41
	T10	8	10			12	1		11		1			1				44
	Total	29	41	0	1	52	1	0	35	0	3	2	0	4	0	1	0	169
Traditional Teacher	T2	12	13			12		1	10									48
	T4	9	16		2	14			12									53
	T9	6	10			3			7									26
	T11	7	6			16			13	2								44
	T12	11	8			10			7									36
	T13	7	10			18			11									46
	Total	52	63	0	2	73	0	1	60	2	0	0	0	0	0	0	0	253

Fig.4.8. summarizes the major questioning categories under teachers groups. It shows that teachers under modern group asked variety of questions while traditional teacher mainly asked lower-order questions. No higher-order and conceptual change questions were found to be asked. Transition teachers, on the other hand, asked all sort of questions but the frequency of higher-order and conceptual-change questions were found very poor.

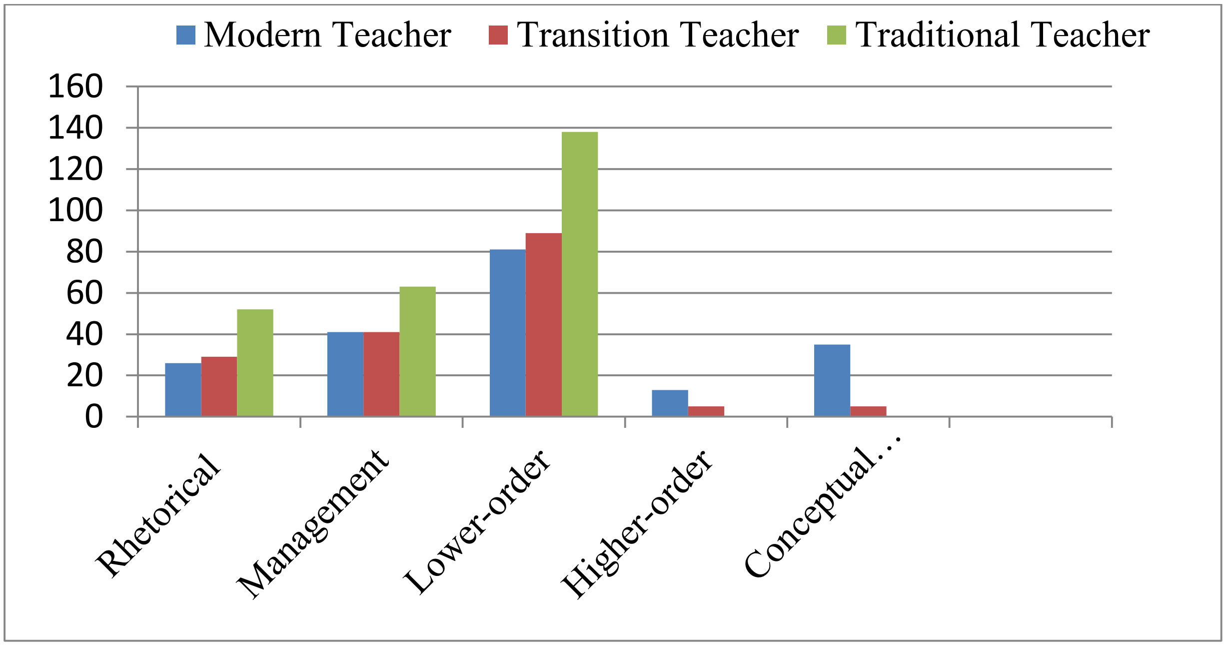

Figure 4. 8. Frequency distribution of major questions categories by teachers

4.5.3. Students responses

Table 4.19 summarizes the frequency distributions of students 'responses by teachers' categories.

In the case of modern teachers, varieties of students' responses were found. This includes long responses express thinking with the frequency of 9 and long responses express knowledge with the frequency of 31 along with many other responses categories. It is the reflection of their richness of asking varieties of questions comprise higher-order, lower-order and conceptual changes.

In the case of transition teachers, a mixture of students' responses was found also. The most prevalent responses were word or phrase type with the frequency of 65. In addition to that long response express thinking and express knowledge also found with the frequency of 2 and 18 respectively. It indicates that they asked many lower-order questions along with very few higher-order and conceptual change questions.

In the case of traditional teacher, least variety of student responses evolved. The responses were limited with word or phrase with the frequency of 113. A few long response express knowledge were found but long response express thinking was totally absent. It confirms that they asked least variety of question limited to lower-order which results word or phrase type response.

Table 4.19. Frequencies of different types of students responses by teachers

Category	Teacher	Type of students' responses							Total
		Long response express thinking	Long response express Knowledge	Incomplete response	Incorrect response	Word/ Phrase	I can't, I don't response	No response	
Modern Teacher	T1	2	8	1	1	14	1	13	40
	T3	1	6	2	1	22		13	45
	T3	3	11	2	1	16	2	6	41
	T6	3	6	2	1	13	2	8	35
	Total	9	31	7	4	65	5	40	161
Transition Teacher	T5		4	1		14		13	32
	T7		4			19	3	10	36
	T8	1	5			20		10	36
	T10	1	5	3	1	12	4	12	38
	Total	2	18	4	1	65	7	45	142
Traditional Teacher	T2		2			20		14	36
	T4		3			24		17	44
	T9		0			10		5	15
	T11		2			22		13	37
	T12		2			14		9	25
	T13		1			23		11	35
	Total	0	10	0	0	113	0	69	192

4.5.4. Teachers feedback

Table 4.20 summarizes the distribution of feedback according to teacher's category. It shows that science teachers under modern group offered almost all kinds of feedback to students' correct or partial correct and incorrect or no responses. They had very rich repertoire of the instructional move i.e. feedback. Regarding correct or partial correct responses, science teachers under this category offered feedback 'restate student response-direct instruction' with the frequency of 48. Feedback type neutral comments-asking question; precise question for elaboration; and ask student to judge were found good in number with the frequency of 52, 6, and 4 respectively. They offered precise knowledge through the feedback 'explicit correction-direct instruction' and 'no comment-direct instruction' to students incorrect and no response with the frequency of 17 and 10 respectively. The feedback 'restate question along with comment', 'constructive challenge', and 'response give back to student via question' were found with the frequency of 9, 7, and 8 respectively. Since teachers under this group offered variety of feedback with different perspectives the teachers are no longer seen as the "knowledge authority" that dominates classroom instruction. Thus, they depicted themselves as the guide of the students to learn. The intension of the feedback "ask student to judge' is to reason out the validity of the given response. It also helps to reduce teachers' authority about knowledge and expertise and student become autonomous learners depending less on their teachers (Nuthall, 1999, Roskams, 1999). These actions are parallel to their beliefs.

Science teacher under transition category offered less variety of feedback to students correct or partial correct and incorrect or no response. But the frequency of different types of feedback was not as good as modern teachers. The feedback 'restate student response-direct instruction' was found high in number to student correct or partial correct response with the frequency of 47. Feedback type neutral comments-asking question; precise question for elaboration; and ask student to judge were found good in number with the frequency of 36, 2, and 2 respectively (Table 4.20). This group of teachers also offered true knowledge via the feedback 'explicit correction-direct instruction', and 'no comments-direction' with the frequency of 25 and 19. However, they try to draw out student ideas and give student back learning responsibility in the case of incorrect or no response through the feedback 'restate question along with comment', 'constructive challenge', and 'response give back to the student via question' with the frequency of 6, 1, and 1. Science teacher in this group offered true knowledge where students chance to explore alternative ideas was absent. Correspondingly, they facilitate student learning by giving them chance to express their ideas. Thus, they show the consistency between their beliefs and practices.

Science teachers under traditional category did not offer different types of feedback (Table 4.20) to students various types of responses. Regarding correct or partial correct student's responses, prevalent type feedback were 'restate student response-direct instruction' and neutral comment-asking question' with the frequency of 83 and 30 respectively. They employed the feedback 'explicit correction-direct instruction' and 'no comment-direct instruction' to student incorrect or no response with the frequency of 48 and 34 respectively. Through explicit correction-direct instruction they transmitted true knowledge to the student and hold the authority of knowledge and think the students as the recipient of the knowledge they delivered. By doing so they showed consistency with their beliefs.

Table 4.20. Frequencies of Feedback by teachers' category & by type of response

	Teacher(T)	Types of teacher feedback									Total
		Correct / Partial correct response				Incorrect /No response					
		Restate student response-direct instruction	Neutral comment-asking question	Precise question for elaboration	Ask student to judge	Explicitly correction–direction instruction	No comment-Direct instruction	Restate the question along with comment	Constructive challenge	Reponses give back to the student via question	
Modern Teacher	T1	17	9	3	1	5	3	1	2	4	45
	T3	10	14			7	4	2	2	1	40
	T3	9	15	2	3	2	1	4	2	3	41
	T6	12	14	1		3	2	2	1		35
	Total	48	52	6	4	17	10	9	7	8	161
Transition Teacher	T5	11	9	2	2	5	2	1			32
	T7	11	6			8	10		1		36
	T8	12	11			7	3	2		1	36
	T10	13	10			5	4	3			35
	Total	47	36	2	2	25	19	6	1	1	139
Traditional Teacher	T2	17	4			9	6				36
	T4	16	11			10	7				44
	T9	5	4			2	4				15
	T11	18	4			8	7				37
	T12	9	3			9	4				25
	T13	18	4			10	6				38
	Total	83	30	0	0	48	34	0	0	0	195

Figure 4.9 summarizes the total feedback teachers employ in the lesson discussion. It shows that science teacher under modern group employ more neutral feedback then evaluative one. On the other hand, transition teacher used more evaluative feedback while traditional teachers employed almost evaluative feedback, they used neutral feedback occasionally.

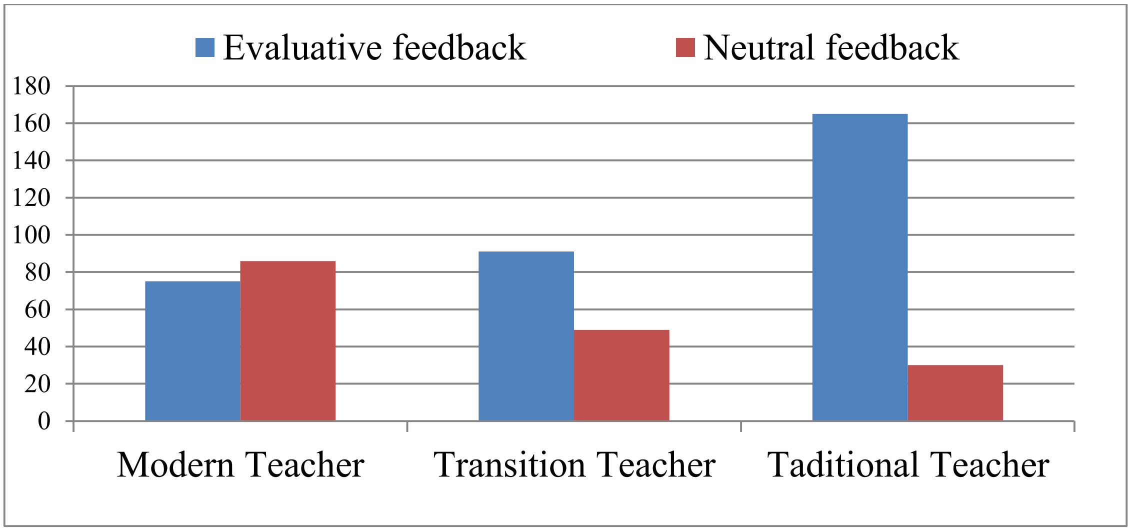

Figure 4.9. Distribution of feedback by types

4.5.5. Direct observation

Table 4.21 summarizes results of the teaching styles by teacher's category. Results indicate that modern teachers used structure-oriented as well as student-oriented practices. They allowed students to work in group and asked them to help in lesson activity under student-oriented practices which is consistent of their beliefs.

Transition teachers basically did structure-oriented practices. But they were not too strict to follow all the aspects. Although, some of them were concerned about group discussion but in reality it was absent in their actions. Thus, they showed inconsistency of their beliefs and practices.

Traditional teacher, on the other hand, strictly followed structure-oriented practices correspond to teacher-centered teaching. By following structure-oriented practice strictly, they again supports their belief about mechanical view of teaching i.e. teacher will perform some routine work including lecturing and check student leaning by asking question.

Table 4.21. Summary of the classroom observation by teachers' category

Category	Teacher	Structure-oriented practice					Student-oriented practice			Enhanced activities			
		SLG	RSH	PS	CSEB	L&C	WG	HPCAT	EROW	WP	SMP	WE	HD
Modern Teacher	T1	-	×	×	-	×	-	-	-	-	-	-	-
	T3	-	×	-	×	×	×	×	-	-	-	-	-
	T3	×	×	-	-	×	-	-	-	-	-	-	-
	T6	-	×	×	-	×	×		-	-	-	-	-
Transitional Teacher	T5	-	×	-	×	×	-	-	-	-	-	-	-
	T7	-	×	×	-	×	-	-	-	-	-	-	-
	T8	-	×	-	×	×	-	-	-	-	-	-	-
	T10	-	×	×	-	×							
Traditional Teacher	T2	×	×	×	×	×	-	-	-	-	-	-	-
	T4	-	×	×	×	×							
	T9	×	×	-	×	×	-	-	-	-	-	-	-
	T11	-	×	×	×	×							
	T12	×	×	×	×	×							
	T13	×	×	×	×	×							

"×"= indicates observed; "-"= indicates not observed

Legends: SLG=State learning goals; RSH= Review students' homework they have prepared; PS= present a short summary of the previous lesson; CSEB= Check students' exercise books; L & C= Lecture and check by asking questions; WG= working in group; HPCAT= help in lesson and activity; EROW= Evaluate and reflect their work; WP= work on project; SMP= Student make product; WE= writing essay; HD= hold a debate

CHAPTER 5

DISCUSSION

5.1. Overview of the chapter

In the previous chapter, results regarding teachers' beliefs on teaching-learning aspects, teaching practices, relationship between beliefs and practices and factors that influence beliefs and practices were explained. In this chapter, the results of each research question are discussed with various reviewed literatures in other contexts.

5.2. What kind of beliefs do science teachers hold regarding various aspects of teaching-learning?

The results of the study revealed that science teachers' belief regarding teaching and learning did not partition within a particular belief dimension. The science teachers of the researched secondary schools possessed direct transmission belief regarding student role; classroom environment and curriculum aspects of teaching and learning. On the other hand, the participants' support of modern belief on teacher role, and teaching style aspects of teaching-learning are stronger than that direct transmission beliefs (Table 4.1, 4.2, 4.3, 4.5, & 4.6). The findings are parallel to the previous research conducted by Levitt (2002); Tsai (2002); Koballa et al., (2000); and OEDC (2009).

The most encouraging result of the present study is that the participants are aware of the contemporary teaching strategies (Table 4.1 & 4.2). They believed that pupils are the heart of the instructions generally called learner-centered teaching and learning. Student-centered learning requires students to set their own goals, determine resources, and activities that will help them meet those goals (Jonassen, 2000). This result coincides with the research conducted by Levitt (2002) and OECD (2009). They conclude that teaching strategy should focus mainly on student learning generally called student-centered learning. OECD (2009) reveals that all the countries, accept Italy, the average endorsement of modern beliefs is stronger than that of direct transmission beliefs. It is assured that the secondary schools' teachers of Bangladesh have gained this notion of modern teaching from the in-service training 'especially TQI training'. It is evident that teachers who received TQI training along with short term overseas training (OT) and CPD held modern beliefs about teaching-learning (Table 4.1 & 4.2).

Concerning the teachers' role, the participants' beliefs aligned with modern notions about teacher's responsibilities (Table 4.1 & 4.3). Beliefs regarding the role of teacher as facilitators, guide, provocateur, friends and so on (Tobin, et al., 1994). This result is similar with the result of Levitt (2002); Tsai (2002) and OECD (2009). In most countries, teachers believe that their task is not simply to present facts and giving opportunities to practice rather create learning opportunities and guide discussion (OECD, 2009). Interview result, however, revealed that participants had traditional belief that the role of teachers is to dispense facts or to transmit a body of knowledge (Table 4.3). It is vivid that teachers, who had least teaching experience, received a few or no training and also low education possessed traditional beliefs (Table 4.8 & 4.9). It is found that teaching experience shows a significant effect on the vast majority of beliefs (Brousseau et al., 1998, OECD, 2009).

Concerning about student' role, the secondary science teacher's possessed traditional beliefs regarding students' role. They thought student as passive recipient of the information (Table 4.1 & 4.4). This results is in contrast with the research conducted by OECD (2009). Teachers, in most of the OECD researched countries, believe that students are the active constructor of their own knowledge. It can be speculate that the science teachers of the researched secondary school of Bangladesh did not have complete understanding about each aspects of teaching-leaning. This partial or incomplete idea about teaching-learning is called naïve constructivism (Prawat, 1992). Dewey already cautioned about this problematic form of constructivism. He argued that student engagement in so called teacher's guided discussion is not the best measure of educational value.

An important finding of this research is that teachers were incoherent in expressing their beliefs to a particular aspect of teaching and learning to its associated aspects. For example, most of the teachers in this study believed in teachers mediating role to monitor students' understanding and guide discussion so that all student have opportunities to not only express their understanding in language but also engage in activities such as clarifying, elaborating, justifying and evaluating alternative points of view. However, participated teachers did not believe in students' autonomous behavior as independent knowledge discoverer rather thought as passive recipients of the information, listening to the explanation from teachers and taking notes (Prawat, 1992; Fosnot, 1996). It is also evident that when teachers provide students with opportunities to feel supported, challenged, and autonomous in the classroom, student' motivation increase. Conversely, when teachers predominate role in the classroom is to transmit knowledge as an authority students' intrinsic motivation decreases (Wetzel, 1998). In this regard, it can be speculated that low thinking ability and low interest in science of Bangladeshi secondary science student attributed by passive recipients of information. Researchers and practitioners agree that meaningful learning occurs best when students are active participants, not passive recipients (Dawkins, 2004). A modern view of learning rejects previous ideas that pictured learners as vessels into which teachers could pour new ideas and information-straight from the teachers' brain to the students'- brain, completely intact. Instead, it views learners as having complex networks of understanding that they have developed from their experiences. As they encounter new experience through their senses, they attempt to fit these into their existing networks. However, good teachers can provide environments that support learners in the process of establishing these connections and make senses of what they experienced (Dawkins, 2004).

Regarding learning environment the participants possessed ***traditional beliefs***. They believed that a calm and quiet classroom is necessary to preform whole class instruction through lecturing and carry out routine activities (Table 4.1 & 4.5). It may be speculated that secondary science teachers are highly influenced by the classroom culture predominated across the country. Usually teachers teach as the way they were taught in their student life. Moreover, they may not have any idea about interactive and dynamic classroom environment. It is said that teachers who are insecure in their knowledge of science can find the uncomplicated transmission of knowledge attractive (Osborne & Freyberg, 1985). Transmission view of teaching avoids discussions (since learners lack knowledge worth for consideration) and interactions which might reveal teachers' uncertain knowledge and so alter power of relationships in their classroom (Malcolm Carr et al., 1994).
Concerning the curriculum/learning content aspect of teaching-learning, the participants' beliefs analogous to those of traditional beliefs (Table 4.1 & 4.6). The result indicates that teacher

participants were comfortable with fixed and rigid curriculum which is seen as the list of things to be taught. Secondary science teachers may not aware about the skills that students are likely to need in order to face the complex problem-solving circumstances of today's society. In addition, social expectation added values on individual 'product' and 'achievement' through year-end test based on content of the science textbook. This situation put the teachers into pressure for covering syllabus rather than using content for the development of students' thinking and reasoning to contribute to problem solving. During the interview, some of the participated teachers' beliefs were found analogous to modern beliefs of the curriculum which is interactive and dynamic, focusing thinking and reasoning. In the interview, most of the teachers participated stated that the reason for teaching facts because students have to cut good scores to promote to the next grade or pass the exam. Although some of the science teachers of Bangladesh have modern beliefs about curriculum aspect of teaching and learning, due to the constraint (i.e. social expectations) they could not translate it into real culture. When constraints act as myths for culture (i.e. time, scarce resources, control, social expectations), they may suppress any change considered, even when teachers are strongly committed to personal change (Tobin et al., 1992).

This is not surprising that Bangladeshi secondary science teachers have variegated beliefs regarding teaching-learning aspects because like other teachers in other countries' (see Tobin et al, 2004), they do not have the opportunity to inquire their own epistemological beliefs. As stated by Taylor (1998), epistemological self-inquiry involves reflecting critically on the myths that frame one's own pedagogy, particularly the framing assumptions which shape and are shaped by the daily routine enactment of classroom roles. In addition to that constraints are the major obstacles to change in teachers in line with modern beliefs of teaching and learning.

Part of the solution of this state of beliefs is (Taylor, 1998) to deconstructing the hegemony of modernist science for science education to empower teachers with rich understandings of the historical and cultural contingency of scientific and mathematical ideas and methods. Until teachers become aware of the mythical nature of modernist science, they are likely to remain intellectually and emotionally unprepared to consider seriously the prospects of engaging their students in existentially challenging modernist perspectives.

However, science teachers' beliefs regarding teaching-learning should be acknowledged and addressed in order to develop professionally. In this sense, they should be given the chance to explore their own beliefs and reflect on them. Raising awareness of their own beliefs is the first step to change and then challenge those beliefs while providing opportunities to examine and integrate new formation into their belief system (Kagan, 1992; Pajares, 1992). Culture of the classroom practice is another important factor which can change teacher's belief. It is empirically evidenced that some individuals changed their beliefs based on classroom learning, while other changed their beliefs when faced with the reality of the classroom (Veenman, 1984; Joram & Gabriele, 1988; Simmons et al., 1999). So science teachers of Bangladesh should be given opportunities into real classroom practices and interaction of learning through pre-service, in-service, and other professional trainings.

5.3. What kind of practices do science teachers do in the actual classroom?

5.3.1. What type of interactions is present in the classroom?

The science teachers of Bangladesh take on almost full responsibility of the science talk in a non-interactive discourse manner where students' participation is negligible or completely absent. They had actions i.e. predominant lecturing restricting students' participation; a big gap between teachers' initiation and students' initiation as well as between teachers' initiation and students' response. In addition, students were not able to express their own ideas since students' talk-initiation is very infrequent (Table 4.6 & Fig. 4.1). The power of relationship between teachers and students was found very weak where the responsibilities and decisions about learning were not shared. Teacher takes all the decision regarding teaching and learning in a control environment. The study revealed that student's participation was not encouraged since the first three categories of frequencies were found infrequent (Table 4.6). Teachers play predominant part in influencing the students directly. They talk more, listen less, and lead the class in an authoritative manner. These findings seem to consistent with the study by Claude (2014) and Chafi et al., (2014). They found that teachers hold the authority and restricts students' participation through much more lecturing and providing scarce opportunities for pupils learning.

Controlling environments have been found to have negative effect on perceived competence and participation, which results in decreased intrinsic and self-motivation. On the other hand, pupils are motivated by teachers who know, support, challenge and encourage them to act independently from each other and even from the teachers (Gervis & Capel, 2013). An autonomy-support environment is one in which the teacher gives increasing responsibility to the pupils, e.g. for choice/options about what they want to do; encourage pupils' decision-making by spending less time talking, more time listening, making less directive comments, asking more questions, and not giving pupils solutions; allows pupils to work in their own ways; and offers more praise and verbal approval in class (ibid, 2013, p.152). Such an environment supports pupils' academic and social growth by increasing their intrinsic and self-motivation to succeed at school, self-confidence, perceived competence and self-esteem. With a similar fashion, Rogers (1983 as *cited* in Gregory, 2006) stated that "creativity in learning is the best facilitated when self-criticism and self-evaluation is primary and evaluation by others is of secondary importance".

In order to increase interaction, science teachers need to present themselves as co-learners in the class. They should create a learning environment where teaching and learning are in a symbiotic association such that the teacher teachers and learns from student and the student learns and teaches the teacher (Beccles, 2012).

Classroom authority needs to be shared equally both between teachers and the students (Weimer, 2002; Beccles, 2012). Teacher need to change the pattern of questioning from the traditional way of checking students' knowledge. In order to increase interaction, science teachers need to set hands-on activities, group or peer work, subsequent student presentations and discussions. Thus, students need to be encouraged to liberally participate in such activities and willingly express their thought. Teacher should avoid the language that criticize and justify authority. Language like this has a subtext that relates to power and control (Weimer, 2002). Power and authority is one of the main characteristics of didactic teaching which limits interaction and active participation. However, when teaching is learner-centered, power is shared rather than transferred wholesale. Power sharing benefits students and learning it also benefits teacher and learning environment in a class and at an institution (ibid, 2002, p. 30). Through power sharing teacher can minimize the student dependency on them. Because teacher-student relationship can become entangle with issue of codependency and all psychological benefits that accrue to both parties when relationship are dependent.

5.3.2. What type of questions do teachers ask?

They study revealed that the questions researched secondary school science teachers asked mainly lower order type (50%) basically for checking students' content knowledge (28.2%). Moreover, they asked a large number of rhetorical question (17%) and management strategy (23%) questions. Higher-order (3%) [Analyze (1.3), Evaluate (0.97) and Synthesis (0.68)] and conceptual-change questions (6.3%) were rarely asked (Table, 4.7, Fig. 4.2 & 4.3). Studies of the classroom discussion show that teachers are generally not good for asking high-quality questions. Most teachers questions are short-answer questions that require the students to recall factual knowledge, while only a small percentage of teacher questions demand higher cognitive skills. Beccles (2012) and Swift et al., (1988), for example, reported similar results. Swift et al., (1988) reported that 85.9% percent of teachers' questions in middle school science were at recall level. In Ghana, 42% question were asked for assessing student's content knowledge (factual knowledge), question assessing students' ability to apply, analyze, evaluate, and create were found 5%, 1%, 2% and 0% respectively (Beccles, 2012).

Similar results also reported by Yip (2004), and Ewing and Whittington (2007). Yip (2004) reported that teacher asked lower-order questions most frequently which constitute one third of the teachers' question. Correspondingly, Ewing and Whittington (2007) found that professor in their study primarily asked closed-questions during class session and they questioned students at the remembering level of cognition. Professor asked evaluating level questions occasionally. Creating level questions were rarely asked.

Learning begins with questioning and it is the first stage in the learning process (Jarvis, 2006). To create a disjunctural situation- a situation when ones memories of past experiences and ones interpretation of present situation are not in harmony-teachers use questions. It is evident that teachers who are using various questions during classroom discussions are enabling students to practice a wide range thought processes. On the other hand, if teachers use one particular type of questions frequently, students' thinking may not be challenged at the higher cognitive levels (Blosser, 2004). Thus, the use of multiple types of questions is recommended during class sessions for greater interaction with the courses content.

Blosser (2004) asserted that teachers must be aware of the types of questions they are using during class sessions, the purpose for using various type of questions and the amount of time needed for students to process different type of responses. When teachers ask, for example, open-ended or higher-order questions that require students to formulate answers on their own the amount of time needed for student to think higher while simple closed-type or lower order questions require little or no processing time.

Each of the question type has its own implications in students learning. Students who are exposed with management-type questions may become bored. Students who are not given adequate time to truly process a rhetorical question, soon cognitively disengage from content. Students who are frequently asked closed-type questions learn to value the easy recall of facts (Ewing & Whittington, 2007). If students are to become better problem solvers and discoverer; comprehend that intuitive; every ways of explaining the world around them need to be adapted in order to better describe, predict, explain; and control natural phenomena–the need to develop higher order thinking skills (Blosser, 2000). By encouraging true dialogue (Lemke, 1990) through quality question can able to develop higher order thinking skills and conceptual understanding.

5.3.3. What type of students' responses is triggered?

Results of the analysis of the students' response show that around 50 % of the responses was in word or phrase type. No response category was found in high percentage (31%) (Table 4.8). There were very few long reasoned responses which express *thinking and reasoning* (2%). Similar trends was also found in the case of long response expressing *knowledge* (11.9%). This findings seem to consistent with the study by Pimentel and McNeill (2013) conducted in England. They found students' responses, which were predominantly single words/short phrase (50%) or response that did not include reasoning (5%), the reasoned response which is very rare accounted for only 3%.

Since students' responses remain brief similar to word or phrase and teacher-framed therefore minimizing their role in the co-construction of meaning or knowledge (Chin, 2007). The prevalence of word or phrase type response indicates that an authoritative nature of interaction was existed in the science classroom. Scott (1998) stated that in an authoritative discourse, students' utterances are often given in response to teacher question which consist of single, detached words interspersed in teacher delivery.

Nature of the student's responses is the alternative angle to look about the type and nature of questions teachers employ in the lesson discussion. Beccles (2012) asserted that the quality of students' answers, to a large extend, is nurtured by the type of questions or statements science teacher use in class. Prevalence of words/phrase type response is the indication of asking many lower-order questions and one of the main characteristics of didactic teaching because, the nature of responses are the mirror by which one can assume the type of questions were asked. If the response, for example, is similar to a sentence/s and express thinking and reasoning, it can be assumed that the question was open-ended and belongs to higher order category. On the other hand, if the response is detached and similar to word or phrase, it can be thought that the asked question was close-ended and belong to lower-order category. Long students' response expressed thinking, on the other hand, is an indication of student cognitive involvement in higher level thinking. Diversity of questions ultimately generates range of responses. In order to get various responses student should be given more room to think and to formulate the answer and respect and accept the student's answers whether viable or not. The fact is that "no response" is predominant when teacher usually accept correct answer. Consequently, without ensuring the answer, students do not take part in the lesson and consequently they make mistake again. Besides, Beccles and Ikeda (2011) identify many other reasons for small number of responses. Together they reported that teacher remarks to students' incorrect answer, classroom activities, traditional setting, unclear lesson content, student poor scientific knowledge base, unclear questions, and language barrier.

Another well-established probable cause of the low response could be the fact that students traditionally view that science teachers normally present knowledge to them. Students perceive themselves as receivers of knowledge so they are not motivated to engage in thinking process to develop scientific knowledge (Beccles, 2012). In order to get long responses expressing thinking and reasoning, teachers should ask higher-order and conceptual change question and give student more time to formulate the answer of the those questions. Teacher should not embarrassed by silence. They should find technique for coping with silence such as going and finding a chair and deliberately sitting down-communicating that we (teachers) have plenty of time to wait for the answer (Jarvis, 2006). Science teachers of Bangladesh should bear in mind that the questions should neither be too easy nor too difficult but should be of appropriate difficulty so as to be relevant to the ability of the pupils.

5.3.4. How does teacher react to students' various responses?

The analysis of feedback in various science lessons described that science teachers in secondary schools of Bangladesh were comfortable with giving precise information through direct instruction along with explicit correction in case of students' incorrect or no responses (Table 4.9). Beccles and Ikeda (2011) report Ghanaian science teachers' reaction to student's incorrect response and find different behavior. They find that science teacher either ignored or rejected students' in correct response. The most common and predominant type of feedback to students' correct/partially correct responses were '*restating student correct answer-direct instruction*' (C-S). It was accounted for 36%. The second prevalent type of feedback was found '*neutral comment-asking question'* (C-Q1). Among the feedbacks it was accounted for 23.8%. The feedback type '*precise question for elaboration'* (Q1) and '*ask student to judge'* (Q2) were found less frequent by 1.6% and 1.2% respectively of the lessons analyzed. Alternatively, five types of feedbacks were found in the case of students' incorrect or no responses. Among which, '*explicit correction-direction instruction*' (S-Q) was found predominate. It was accounted for 18%. The second prevalent type of feedback was found '*no comment-direct instruction'*(S). Among the feedback it was accounted for 12.7%. The feedback in the form of *'restate the question along with comment'* (C-Q2); '*constructive challenge*' (Q3); and '*response give back to the student via question'* (Q4) did not have much or very negligible room in the case of incorrect or no response dimension in various science lessons studied. They were accounted for 3 %, 1.6% and 1.8% respectively. It was found that 67% of teachers' feedback was evaluative and corrective type while 33% belongs to neutral or facilitative type to students' correct, partial correct, incorrect or no responses. The findings of the study somehow corroborate with the findings of Chin (2006). She stated that the thrust of the teachers' utterances in the F-move consisted not just of an evaluative comment and further statements (i.e., C-S couplet) rather comment or a further "productive" question, in the form of a C-Q couplet that took students forward in their thinking.

However, some features of inquiry classroom teaching also revealed as portrayed in the science lessons studied. Teachers tried to remain neutral in responding to students' correct or incorrect or no responses through the form of feedback 'comment-question' couplet or 'question alone'. Through this type of feedback teacher retained a long discussion, tried to draw out students' ideas with variety of questions. The purposes of the questions were calling for reasoning, asking for explanations, guesses, inference, encouraging wider response, driving towards the focal point, providing hints, asking for justification and so on (Kawalkar & Vijapurkar, 2011a).

Feedback, the third part of IRF structure in typical lesson discussion, is the most crucial part of teaching and science talk. It constructs cognitive scaffolding (Chin, 2006) as well as dialogical (Lemke, 1990) pattern of discourse in the classroom. Cognitive scaffolding engaged students in more cognitively active roles such as formulate hypothesis, predict outcomes, brainstorm ideas, generate explanations, make inferences and conclusions, as well as to self-evaluate and reflect on their own thinking (Chin, 2006). Research finding made an assertion that active discussion, for example, dialogical one, both between pupils and between pupils and teacher need to take account for effective or meaningful learning (McCormick & Leask, 2005).

Learning theorists, for example, Rogers (1969), Knowles (1978), Tough (1979) and Mezirow (1991), have all argued that effective learning is self-actualizing, self-directed, self-planned and self-transformative. Effective/meaningful learning (Entwistle, 1990) requires pupils to engage in an active reconstruction of information, to make new links and test old ones, to resolve contradictions and to identify underlying principles (McCormick & Leask, 2005). It happens best where social interaction, particularly between a learner and more knowledgeable (usually teacher) others, is encouraged. Teaching styles therefore need to take account of the need for discussion, both between pupils and between pupils and teacher (ibid. 2005 p. 279). The results of teachers' feedback in various lessons studied did not support meaningful or effective learning. The pattern of interaction was found as authoritative and maintained a typical IRF sequence.

The analysis of teachers' follow-up (F) in the classroom contributes to an understanding how the "F" part of the triadic dialogue can discourage students' active involvement in construction of knowledge as well as limiting classroom discussion as a part of a teaching sequence. This notion of teaching as revealed through this study, "in the form of feedback", is completely opposite view of teaching as stated in the teacher education curriculum of Bangladesh. The teaching is stated as follows:

> Teaching should ***actively involve*** the learners in the learning process through varieties of learning experiences, for example, Hands-on, ***group/peer discussion***, investigation, practical work (MoE, 2006).

However, it is also found that teacher's feedback in the form of C-Q couplet or Q alone, in both the cases of correct or incorrect students' responses evolve an elaborative sequence of interaction similar with the type IRFRF (Mortimer & Scott, 2003). They identify IRFRF chain, the elaborative feedback, where the teacher is followed by a further response from a student. This form is typical of discourse that supports a dialogic interaction. As a part of the feedback, the teacher could repeat a student's comment to encourage them to continue, elaborate on the comment, or ask for elaboration. By establishing this pattern of discussion, the teacher is able to explore students' further ideas (Mortimer & Scott, 2003).

Another important finding of the study is that teachers' feedback was found dependent on teaching experiences as well as in-services trainings. Experienced teachers in the study used the feedback to scaffold students' thinking at conceptual level. They used questions, as feedback, to elicit deeper thinking of the students and drive them toward self-directed learning rather than making explicit correction or giving more scientific ideas in responding to students' incorrect or no responses. This approach of teaching is called facilitation. This approach emerges out of a particular philosophical framework that espouses the self-directed nature of learning (Gregory, 2006). By doing so teacher creates a learning environment within which learner can select and direct their own learning and development (ibid. 2006. p.99).

Surprisingly, it is found that secondary science teachers in Bangladesh employ more feedback to students' correct and partial responses (Table 4.10) yet they put-down incorrect answers and no response. Traditionally, they like correct response from the students which is in contrast with the modern philosophy of teaching and learning. Teacher should give value to student's incorrect or no response. Because, it unveils students' thought process, conceptions, misconceptions, and immature ideas. Science teachers should use those naïve ideas from the students to develop lesson plan and lesson content.

In Bangladesh, active involvement of the learners in the learning process through facilitation is the core of teaching science that allows learners into dialogical discussion. One of the hurdles can be assumed in adopting facilitative teaching practice has been that teachers have few operational models to understand what facilitation look like and what kind of teachers' behavior that engaged students into dialogical discussion by which meaningful learning occur. In this study, while an attempt was made to make an explicit example of facilitative approach of teaching with the experienced teacher. On the other hand, novice teacher's (less experienced teacher) example of the study indicates traditional teacher-centered teaching. The researcher believes that these two examples of classroom teaching would help the teachers to think and frame their practices that make a science lesson into collaborative and facilitative one.

5.3.5. What type of verbal discourse is present?

Results regarding discussions shows that around 67% classroom discourse was authoritative typified as monologue. The result of the study consistent with the study by Chafi et al., (2014). They found that in Morocco, primary teacher operating highly conventional discourse pattern where student opportunities to take part in the discourse is very scarce.

The authoritative discourse as categorized by Scott (1998) has some specific characters. Where teachers invested in authority which tends to discourage interventions; intended to convey information and often based on instructional questions; the students often response to teacher questions which often consisting of single, detached words interspersed in teacher delivery and often direct assertions. The flow of monologue is typical IRE. However, there were some discourse patterns other than the traditional IRE sequence. Some exchanges were of the IRFRF pattern.

Depending on the nature of the activity, some questioning sequences had the quality of exploratory and facilitative rather than evaluative talk (Chin, 2006). The results also revealed that the follow-up (F) component of the IRF structure could take various forms. Therefore, it is suggested that by changing the third move of an IRF questioning sequence from an explicit evaluation to one which includes "responsive questioning", teacher can make their classroom discourse more thought-provoking and stimulate more elaborate and productive student responses (Chin, 2006). To disrupt the IRE organizational pattern, Mercer and Littleton (2007) suggest many strategies which include: encouraging student's ideas, referring back to students' responses; asking open questions; and encouraging other student response before giving evaluative feedback to responses.

As Mortimer and Machado (2000) have pointed out, the IRF pattern of discourse is authoritative or univocal as long as the feedback from teacher is an evaluation. However, where the feedback is elaborative, in that it allows for a further extension of the response by students, or elicits new ideas and contributions from them, the IRF pattern corresponds to a dialogic function. It is now clear of why the secondary science students of Bangladesh do not engage cognitively into the lesson discussion and could not produce productive responses. It is the teachers who make explicit evaluation in the form IRE questioning sequence which ultimately compel the students not to think further. Empirically, it was proven that feedback that does not provide the correct answer explicitly encourage learners to use their own resources in eliciting self-correction and repair (Table 4.11, type 2 discourses). The implicit (neutral) feedback may improve students' ability to monitor their own thinking, and under the appropriate conditions, could be more beneficial than simply providing them with correct form (Chin, 2006). So secondary science teachers of Bangladesh should learn how to make implicit feedback in learning situation for creating better interaction with the students and getting productive response from them.

5.4. Relationship between beliefs and practices

The study reveals that there is a relationship between teachers' beliefs and their instructional practices. The results of the study corroborate with the results of the previous studies conducted by Beck et al., 2000; Haney et al., 1996; Haney and McArthur, 2002; Hashweh, 1996; Levitt, 2002; Roehrig & Kruse, 2005; Uzuntiryaki et al., 2009. They found that teachers' beliefs have strong relationship with classroom practices.

It is found that science teachers holding modern beliefs used very few lecturing in their classroom teaching, besides they allow students to talk and listen to their ideas carefully (Fig.4.7). Teachers accept and praise students' ideas and sometimes use their ideas to develop lesson and to make better interaction. In order to create better learning environment, they avoid the language which criticize, command and justify teachers' authority during lesson discussion. In a nut shell, they used varieties of verbal activists with non-threatening manner so that learners can take part in the lessons willingly. In this case science teachers were facilitating learning. When learning is facilitated, teachers create learning environment so that learners can explore and construct their own knowledge (Weimer, 2002). Fine grain analysis of the teacher-student talk indicates that teacher who possessed modern beliefs have very good repertoire of instructional strategies namely questions and feedback (Table 4.15 & 4.17). It was empirically evident that teachers use variety of question during lesson ultimately engage students into the lesson in multiple ways. When teachers use a number of feedback in different perspective, teachers are no longer found "knowledge authority" which dominates traditional classroom. Science teachers of modern group use several method to engage learners into the lesson physically and mentally (Table 4.18) because there is no single, well-defined best way of teaching (OECD, 2009). The varieties of instructional techniques that the science teacher employs should be considered as aids to the growth of the learners. Teachers should be flexible to make use of different techniques or method according to the circumstances (Das, 1985). It was found that secondary science teachers of Bangladesh holding modern beliefs were very flexible in their teaching practices. They employ various teaching strategies especially questions, feedback, and use more than one methods to engage learners actively into the learning process in constructing scientific knowledge-main idea of modern teaching- and thus, shows the relationship between their beliefs and practices.

Science teachers under transition group used lecturing moderately. In addition to that they allow students to talk and express their ideas. They used the language criticizing and justifying authority moderately (Fig.4.7). Analysis of questions and feedback revealed that teachers used higher order and conceptual-change questions along with other questions categories but the frequency of higher-order and conceptual change questions was not as good as modern teachers (Table 4.15 & 4.17). They also offered various types of feedback to students correct/partially correct or incorrect/no responses. The results of the direct classroom observation indicated that teachers used structure-oriented practices (Table 4.18). Although some of them were concern about student-oriented teaching practices, in reality it was absent. On the other hand, it is evident that they tried to engage learners actively, on the other hand they offered precise knowledge as well as mechanical teaching practice which is in contrast with modern approach of teaching-learning. Hence, they showed the consistency in their beliefs and actual practices. Teachers under this group may not be aware of their beliefs and practices. Not only that sometimes they tried to practice according to constructivist way but the infrastructure, sometimes administration as well as extra pressure limit their interest to teach. Therefore, these results should be brought to them to see the mismatch between their beliefs and practices. Practically, if the teachers become more aware of their beliefs, they will be more inclined to implement the practice in their classroom.

Science teachers under traditional category used lecturing predominantly (Fig.4.7). They did not allow students to express their ideas. Accepting and using/applying students' ideas were totally absent. The categories criticizing and justifying authority in the interaction analysis were found also in high frequency. Results regarding questions and feedback revealed surprising scenario. They asked basically lower-order questions for checking students' content knowledge, yet higher-order and conceptual change questions were not asked at all. They offered precise knowledge through the feedback explicit correction-direct instruction and no comments–direct instruction (Table 4.15 & 4.17). They remained neutral hardly to student incorrect/no responses. They disputed their authority and power of knowledge through delivering lecture and making correction and evaluation of students' misconceptions or immature ideas. Structure-oriented practices were accomplished which is corresponded with mechanical view of teaching-learning. All sort of above discussions confirm that science teachers under traditional group translates their practices according to their beliefs and they were more successful in integrating their beliefs into their practices.

However, some deviations were also found between teachers' beliefs and actual practices. For example, modern teachers were concerned about the active involvement of the learners into the learning process but they sometimes offer true knowledge through direct instruction without taking care of students' naïve conception or misconceptions. Similarly, Transitions teachers concerned about the group discussion but in reality it was absent in their actual practices. It may be the contextual factors which may hinder the teachers to practices accordingly. Because as Laderman (1992); Munby et al., (2000); Tobin and McRobbie (1996) asserted teaching practices is affected by various situational factors such as the nature of the classroom and the curriculum. The present study made an effort to identify the background factors that influence teachers' beliefs and practices. The following section, thus discusses such influential background factors.

5.5. What kind of background factors affect teachers beliefs and practices

The study revealed that teaching experience and in-service training influence teacher's beliefs and their teaching practices. Science teachers who had long teaching experience and received much more in-service trainings possessed modern beliefs regarding teaching-learning aspects. Similarly, those teachers employed more student-oriented practices which include: asking variety of questions, offer different kinds of feedback to students different responses, use several teaching experiences especially they help student to learn (Table 4.4 & 4.5).

The most promising and encouraging finding of the study was that negatively, gender did not exert any influence on teachers' beliefs and practices. This finding is in contrast with what was found in the previous researched conducted by OECD (2009); Belenky et al., (1986), and Schommer-Aikins and Easter (2006). For example, OECD (2009) found that female teachers endorsed direct transmission beliefs less strongly than the male teachers. Similarly, Schommer-Aikins and Easter (2006) recently reported a case where men scored significantly higher in separating knowing.

Surprisingly, the present study found that subject matter knowledge did not exert influence on teacher's beliefs and practices (Table 4.4, 4.5 & 4.13). The results of the present study, however, are in contrast with the results of the previous studies conducted by Uzuntiryaki et al., (2010) and Buehl et al., (2002). They found that subject matter knowledge is one of the obstacles for the science teachers to implement their theory into practices.

Moreover, the results of the study also revealed that teachers who had teaching experience ranging between 9 to 17 years possessed modern beliefs regarding teaching-learning aspects. Similarly, those teachers employed more student-oriented practices which include: asking variety of questions, offer different kinds of feedback in different perspectives to students different responses, use several teaching experiences especially they help student to learn by themselves. This result is parallel to the results of the previous studies conducted by Brousseau et al., (1998); OECD (2009); and Mansour (2009). According to Mansour, experience plays a crucial role in shaping teachers' beliefs about teaching and learning processes as individuals in society. It was found that teaching experience shows a significant effect on the vast majority of beliefs (OECD, 2009) and professionally they are more cooperative with colleagues. Experience is seen to filter decisions made by teachers which makes him or her act in certain manner. Therefore, pre-service science teachers should be offered opportunities to teach as untrained teachers before they formally enroll in the teacher training institute. Recently, Singapore adopted similar policy for increasing teachers' experience in real context.

Another encouraging background factors was in-service trainings found exerting influence on teachers' beliefs and practices. Before this findings, there is a common perception that in-service training positively impact on teachers' beliefs and practices but there was no research evidence to claim the postulates. It is assured that the secondary schools science teachers of Bangladesh have gained this notion of modern teaching from the in-service training “especially TQI training”. It is evident that teachers who received TQI training, they had the ideas about teacher’s role, students ‘role, learning content and learning environment of the constructivist theory of teaching-learning. A closer revision of the ‘TQI training manual’ revealed that lecture method has been replaced by highly participatory approaches of teaching-leaning for the first time in secondary level through this training (MoE, 2008). Thirty seven teaching methods mainly focus on student thinking were depicted in manual. The participants of the training were encouraged for using variety of methods (i.e. individual work, peer work, group work, self-learning, debating and argument) and multiple techniques which include: brain storming, concept mapping, presentation, using variety of question and positive feedback. In this training teacher’s role has been depicted as a facilitator to support student learning and learning responsibility was given back to student as active constructor of knowledge. To promote student’s thinking and active engagement, participants were encouraged using more open-ended and probing questions (through the session questioning skills) as well as employing more positive feedback (through micro-teaching session) in the case of student’s misconception or immature ideas during lesson discussion. It may be speculate that teacher under modern group may get the ideas of using different questions from the training session “Questioning Skills’ of the “TQI” training. The idea how to handle students immature or misconception neutrally, science teacher may get the idea from the feedback called “Sandwich feedback” in the “micro-teaching” session of the training. Overseas training may also have effect on teacher’s beliefs and practices but SBC and B.Ed. training was found non-influential in this case.

Therefore, secondary science teachers of Bangladesh should be given more chance to participate in the in-service trainings so as to get more authentic experience which ultimately and positively shape their beliefs and practices. It is also urgent to identify other external factors which affect teachers’ beliefs and practices prior to implement any new innovation of education.

CHAPTER 6

CONCLUSION

6.1. Overview of the chapter

In the previous chapter, a thorough discussion regarding teachers' beliefs on teaching-learning aspects, teaching practices, relationship between beliefs and practices, and the factors that influence teachers' beliefs and practices were made. In this chapter, thus, the conclusions of the study will be drawn on the basis of this discussion. In addition to that, implications of the study, recommendation for changing teachers' behavior and the direction regarding future research will be highlighted in this chapter. The following sections, each one of the research questions will be addressed in relation to the conclusions that can be drawn from the present study.

6.2. What kind of beliefs do science teachers hold regarding various aspects of teaching and learning?

The results regarding teachers' beliefs have revealed that in Bangladesh secondary science teachers' beliefs regarding teaching and learning did not partition within a particular belief dimension. Less than half of the secondary science teachers of the researched schools hold traditional beliefs regarding teaching-learning; more than one fifth of the participant teachers hold modern beliefs while nearly one third of them hold transitional beliefs. Transitional group was not found in previous research. Science teachers holding transitional beliefs did not have holistic and consistent views about teaching-learning aspects. They possessed modern belief about teaching strategy and teachers' role aspects of teaching-learning. On the other hand, they held traditional beliefs about students' role, learning content and learning environment aspects. Since beliefs about teaching-learning are intertwined, in-service trainings and other professional trainings should address all the aspects of modern teaching-learning in a packaged programme so that the teachers can have a complete idea about modern approach of teaching.

6.3. What kind of practices do science teachers do in the actual classroom?

On the basis of the research findings and discussions, it can be concluded that didactic teaching practices is still prevalent in the researched secondary school science classrooms in Bangladesh while student-centered (facilitative and Socratic) teaching are rarely practiced. Evidently, teachers communicate with student mainly through lecturing, asking many lower-order questions which triggered word or phrase type students' response, correct student's wrong response and praise correct response. Teachers hold the power and authority to control student behavior and lesson content. It is part of what continues to make instruction very teacher-centered and consequently makes many students disinterested in learning science.

6.3.1. What type of interactions are present in the classroom?

It is evident that the science teachers of Bangladesh take on almost full responsibility of the science talk in a non-interactive discourse manner where students' participation is negligible or completely absent. The pattern of interaction in secondary science classroom in Bangladesh is non-interactive and authoritative. Teachers lecture is predominant along with teachers' directions and criticizing or justifying authority. Students' participations in the lesson talk almost absent since students' talk-initiation are infrequent. In this regards, student is not able to share their ideas in the class. They are also only the recipients of knowledge conveyed by the teachers. The culture of lecturing and criticizing is the main barrier of shifting toward new innovation of teacher education.

6. 3.2. What type of questions do teachers ask?

The results regarding the nature of questions indicated that the questions participated secondary science teachers in Bangladesh asked during science lesson discussion at secondary level were mainly lower order questions- basically for checking students' content knowledge. Rhetorical question and the question that ask for classroom management were also found predominant. Negatively, higher-order and conceptual-change questions were rarely asked. In this sense, the science teachers of Bangladesh should ask higher-order and conceptual change question along with other questioning categories in order to engage the students into the lesson in multiple ways. More crucially, the curriculum developers, other professional course developers and other significant stakeholders should take the issue of questioning in science class into consideration so as to better the science education in the country.

6.3.3. What type of responses is triggered?

The most prevalent type of response evolves during class sessions at secondary level science was the *word* or *phrase* type. It counted for 49.7% of the total responses evolved during classroom discussion. The second prevalent type of students' response was *no response* type which accounted for 31%. The response in *long response express knowledge* and *long response expresses thinking* category was very rare. In this respect, in order to get long response with reason secondary science teachers in Bangladesh need to ask more conceptual-change and higher-order questions and need to give student more space to formulate the answers of those questions.

6.3.4. How does teacher react with students various responses?

Most of the cases, secondary science teachers in Bangladesh overtly made evaluation and correction to students all sort of responses. When there was any incorrect response they promptly corrected it through direct instruction. Same reaction was also shown in the case of no responses. Teachers precisely offered true knowledge to the students' no response. They hardly diagnose the reason of making no response. They paraphrased and sometimes made comments with instructional questions to student correct responses.

Secondary science teachers' reactions toward students' incorrect and no response should change. Teachers should consider and use students' incorrect responses as source of content development as well as the creation of meaningful discussion during lesson. Usually science teachers require mere correct answers, reject or put-down incorrect response which consequently leads to low involvement of students in lesson discussion.

6.3.5. What type of verbal discourse are present?

According to the results and discussions, it was found that the pattern of talk in the secondary science classroom is authoritative and monologue. The pattern of discourse is typical IRE or IRF. Through monologue, teachers hold authority, power and control exclusively in their hand. Power is not shared with the students and they are treated as passive recipients of the knowledge. Science teachers of Bangladesh should build up a culture of power sharing. There are many ways to do power sharing with the students. One of the ways is to be neutral in judging students' response. Teachers should use implicit feedback instead of explicitly identify students' correct, incorrect and no responses. This explicit behavior of teachers limits student interaction and breed one-way communication.

6.4. Relationship between beliefs and practices

The results revealed that there is relationship between teachers' beliefs and their actual practices. It was found that teachers who held modern beliefs regarding teaching-learning employed students centered or facilitative teaching practices. On the other hand, teachers holding traditional beliefs employed teacher centered teaching or didactic teaching practices. It was also found that teachers who held modern beliefs had large repertoire of teaching strategies and used strategies that would promote conceptual change. It is suggested that teacher's beliefs should be taken into account in developing any professional trainings, or any changes in the curriculum. It is found that any change in the educational innovation happens only when the changes match with teachers' beliefs.

6.5. Factor affecting beliefs and practices

Among the background factors studied, teaching experiences and in-service trainings were found to be the most influential in shaping teachers beliefs and practices in the context of Bangladesh. It was found that teachers who had long teaching experiences and received much in-services training possessed modern beliefs regarding teaching and learning. Teaching practices, especially questioning, was also found influential by the teaching experience and in-services training.

6.7. Recommendation for changing teaching practices at secondary level of Bangladesh

It is an undeniable fact that the behavior of the teacher significantly influences students' learning. Whatever be the methods or strategies of teaching adopted by the teacher to create conducive learning environment, it is the behavior pattern of the teacher and his or her overall approach and treatment with the students that determines whether the learners can be motivated to learn. In a classroom teaching-leaning situation, there is a constant interaction between the teacher and the taught (Das, 1985).

Research found that teachers favor transmitting knowledge via monologic lecture and ask questions in IRE or IRF recitation format. However, it was empirically found that whenever teacher's feedback in the form of comment-question (C-Q) couplet or question (Q) alone to the correct or incorrect students' responses evolve an elaborative sequence of interaction similar with the type IRFRF. The IRFRF chain, the elaborative feedback, is followed by a further response from a student. This form is the typical of discourse that supports a dialogic interaction. Research suggests, however, that the focus of dialogue in science classrooms revolves around the retention of facts with limited attention given to the development of the students' abilities to engage in meaningful scientific discourse.

The third move (F/E) is one of the customary parts of IRE format discourse where teachers can make the move by his/her own and can use it in a way to achieve the learning objective or learning goal. The third step of the IRE questioning sequence has potentiality for creating productive discourse in a social context of the classroom. In Bangladesh, active involvement of the learners in the learning process through facilitation is the core of teaching science that allows learners into dialogical discussion. One of the hurdles can be assumed in adopting facilitative teaching practice has been that teachers do not have any operational models to understand what facilitation look like and what kind of teachers' behavior engages students into dialogical discussion by which meaning-making learning occur. Therefore, this study suggests using facilitative feedback as a model to ensure productive discourse and healthy interaction for meaning- making learning.

Table 6.1 represents a summary of the teachers' behavior regarding feedback (F/E) to students' various responses. It shows the current practice of feedback and at the same time it also recommends the facilitative feedback which will ultimately fulfill the demand of the expected trend-facilitative and interactive-of science teaching at secondary level in Bangladesh. Instead of corrective or evaluative feedback this study recommends that secondary science teachers in Bangladesh should offer facilitative feedback to students' different responses. Facilitative feedback eventually would ensure prolong discussion; active involvement; good interaction; higher-order thinking and conceptual development results meaningful learning.

In the case of correct response, science teacher should ask further question with subtle affirmation of the response or they can ask other students to judge the answer or the teacher may ask the students for reasoning out to support the answer made earlier. Each of the teacher's effort will guaranty the long discussion and better interaction. Similarly, it reduces teacher authority and allows student more space to think further.

Concerning with the partial correct response, science teacher should use neutral comment with question and precise question for elaboration. If teacher really want student to find out their own answer, they should allow them to explore in order to have self-correction and self-actualization. In the case of incorrect response most of the science teachers at secondary levels make precise correction with direct instruction rather than find out the reason behind their answer and do not use the ideas from the students to make the lesson more interactive. In order to make interactive classroom, thus, the teacher should challenge students why she/he make such a response. It was found that learning become effective when students are challenged. By asking challenging questions teacher can create higher-level cognitive dissonance and lead them to self-directing learning. However, constructive challenge could be potential threatening for some students; it may not work well for all students. Empirical study conducted by Zohar and Aharon-Kravertsky (2005) found that cognitive conflict had dissimilar effects on students' academic levels differences. Science teachers may push back incorrect response to student called 'reflective toss' (van Zee & Minstrell, 1997b). It is assumed that this form of questioning may help teachers shift toward a more reflective discourse that help students to clarify their meaning, consider various points of view, and monitor their own thinking.

There are several reasons for making no student's response in a classroom context. One of which is the teachers' behavior. In case of no response, science teachers usually provide precise information without finding out the reason of making no response and thus, limit students prolong interaction and active involvement in the lesson. This study recommends that teachers should diagnose the reasons and help students to make their own answer through different facilitative feedback as suggested in the table 6.1. By restating, rewording, giving hints, eventually teachers try to "draw out" students' idea instead of letting them precise information.

Table 6.1. Present practices vs. recommended teachers' feedback

	Type of response	Teacher's Feedback	
		Current Practices	**Recommended**
		Evaluative and corrective	**Facilitative feedback**
Teachers' Questions	**Correct**	• restate student's response • saying very good, great answer • you are right, correct answer	• neutral comment with question • ask student to judge • ask the reason to support the answer
	Partially correct	• explicit correction-direct instruction	• neutral comment with question • precise question for elaboration
	Incorrect	• explicit correction-direct instruction • no comment–direct instruction	• reflective toss (bounce back the response) • reconstructive challenge
	No response	• giving precise information through direct instruction	• restate the question with comment • reword the question • ask simpler question • giving hint

6.8. Suggestions for further research

While researching regarding beliefs and practices a numerous metaphor of research is felt to be explored. Some of which includes below:

- Students' belief regarding teaching and learning should be explored because empirically it is evident that teaching is highly influenced by learners' beliefs. If the learners have the view of traditional way of teaching and learning, they may not agree with the principles of inquiry approach of teaching and learning.

- The study identifies some background factors which influence teacher's beliefs and practices. But there are some other external and contextual factors which have strong influence on classroom pedagogy. So a broader study is needed for identifying those mediating factors in order to implement newly develop education system that is consistent with modern approach of teaching and learning.

- Nature of assessment is another important elements leading the teachers to do particular actions. For example, if students' learning were assessed by summative examinations, which favor recall of facts, would prevent the application of inquiry principles by the teachers and cause them to retain with traditional teaching method (Mansour, 2009). Therefore, an urgent study is needed to explore the nature of assessment at secondary level of Bangladesh for becoming conscious about the assessment of whether teachers are in the right track in assessing their students to match with the current reform of education or not.

- Effective science teaching is more than knowing science content and some teaching strategies (NRC, 1996). Skilled teachers of science have special understandings and abilities that integrate their knowledge of science content, curriculum, learning, teaching, and students. Such knowledge allows teachers to tailor learning situations to the needs of individuals and groups. This special knowledge, called "pedagogical content knowledge," distinguishes the science knowledge of teachers from that of scientists. It is one element that defines a professional teacher of science. Therefore, there is necessity to explore this especial knowledge of science teachers to check their professional competence whether they are capable of implementing new innovation of science education in the context of Bangladesh.

- Researchers, for example, Mansour (2009) raised questions regarding teacher educators' roles in developing teachers' knowledge, beliefs and practices, as well as questions about teacher educators' roles in changing teachers' beliefs and practices. A number of researches argue that any process of change in teacher education needs to be cognizant of the motivation and attitudes of teacher educators themselves (Robinson & McMillan, 2006; Welmond, 2002). Internationally, there has been a lack of attention to research on teacher educators (Robinson & McMillan, 2006). Therefore, this calls for research that focuses on teacher educators' beliefs and views concerning their personal practical knowledge of teacher education programmes.

- Researchers have argued that significant changes in teachers' instructional practices come only after there are fundamental changes in teachers' beliefs systems and that these changes are not necessarily linear. Therefore, there may be a lag time between changes in beliefs and changes in practices that was not captured by this study. Therefore, a longitudinal study is needed to explore how teachers beliefs changes over a long period of time and how this change influences their practices.

REFERENCES

Abell, S.K. & Roth, M. (1992). Constraints of teaching elementary science: A case study of a science enthusiast student teacher. *Science Education,* 76(6), 581-596.

Abell, S.K. (1990). A case for the elementary science specialist. *School Science and Mathematics*, 90(4), 291-301.

Abelson, R. (1979). Difference between beliefs system and knowledge systems. *Cognitive Science,* 3, 355-366.

Ackermann, R.J. (1972). *Beliefs and Knowledge*. Garden City, NY: Anchor Books Doubleday.

Aguirre, J. M., Haggerty, S. M., Linder, C. J. (1990). Student teachers' conceptions of science, teaching and learning: A case study in pre-service science education. *International Journal of Science Education*, 12(4), 381-390.

Ajzen, I. (1985). From intentions to actions: a theory of planned behaviour. In J. Kuhl & Beckman, J. (Eds.), *Action control: from cognition to behaviour* (pp. 11-39). New York: Springer-Verlag.

Ajzen, I. (2002). Perceived behavioural control, self-efficacy, locus of control, and the theory of planned behaviour. *Journal of Applied Social Psychology,* 32, 1-20.

American Association for the Advancement of Science [AAAS] (1989). *Science for All Americans.* New York: Oxford University Press.

Anamuah-Mensha, J. Asabere-Ameyaw, A. & Mereku, K.D. (2004). Ghanaian secondary school students' achievement in mathematics and science: Results from Ghana's participation in the 2003 Trends in International Mathematics and Science Study (TIMSS). Ministry of Education, Youth and Sports.

Aschner, M. J. (1961). Asking questions to trigger thinking. *NEA, Journal,* 50, 44-46.

Baird, J.R., & Northfield, J.R. (Eds.). (1992). Learning from the PEEl Experience. Melbourne, Australia: Monash University Printing.

Balzer, L. (1968). An Exploratory Study of the Verbal and Nonverbal Behaviors of BSCS Teachers and Non-BSCS. Unpublished PhD dissertation, the Ohio State University.

Bandura, A. (1986). *Social foundation of thought and action: A social cognitive theory.* Englewood: prentice-Hall.

Belenky, M. F., Clinchy, B. M., Goldberger, N. R. & Tarule, J. M. (1986). *Women's ways of knowing: the development of self, voice and mind* (New York, Basic Books).

Buehl, M. B., Alexander, P. A. & Murphy, P. K. (2002) Beliefs about schooled knowledge: domain specific or domain general? *Contemporary Educational Psychology,* 27, 415–449.

Bangert-Drowns Robert L., Kulik Chen-Lin C., Kulik James A., & Morgan Mary T. (2013). The instructional effect of feedback in Test-Like Events. *Review of Educational Research*, 83(2).

Bangladesh Bureau of Educational Information and Statistics [BNABEIS] (2009). National Education Survey (Post-Primary)-2008 Statistical Report. Dhaka, Ministry of Education. Government of Bangladesh

Barnes, D., & Todd, F. (1995). *Communication and learning revisited: Making meaning through talk.* Portsmouth, NH: Boynton Cook.

Barron, B. (2000). Problem solving in video-based microworlds: Collaborative and individual outcomes of high-achieving sixth-grade students. *Journal of Educational Psychology,* 92, 2, 391-398.

Beccles, C. (2012). Science Teaching, Classroom Discussion and Contexts in Junior High Schools in Ghana. Unpublished Doctoral Dissertation, Hiroshima University, Japan.

Beccles, C., & Ikeda, H. (2011). Science Teachers' and Students' Dialogue in Junior High School Classes in Ghana: A focus on Teacher Responses to Students' Incorrect Answers. *Journal of Science Education in Japan.* Vol. 35(3), 227-233

Beck, J. Czerniak, C.M., & Lumpe, A.T. (2000). An exploratory study of teachers' belief regarding the implementation of constructivism in their classrooms. *Journal of Science Teacher Education,* 11(4), 323-343

Becker, H.(1991). When powerful tools meet conventional beliefs and institutional constraints. *The Computing Teacher,* 18(8), 6-9.

Bell, B. & Gilbert, J. (1996). *Teacher Development: A model from science education.* London: Falmer Press.

Benson, G.D.(1989). Epistemology and science curriculum. *Journal of Curriculum Studies,* 21, 329-344.

Blasé, J.J. (1986). A qualitative analysis of sources of teacher stress: Consequences of performance. *American Education Research Journal,* 23, 13-40.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives, the classification of educational goals*. New York: David McKay Company.

Blosser, P. E. (2000). *How to ask the right questions*. Arlington, VA: National Science Teachers Association.

Bookfiled, S.D. (1996). *Understanding and Facilitating Adult Learning*. Milton Keynes: Open University press. Pp. 1-49.

Brooks, J.G. & Brooks, M. G. (1993). *In search of understanding: The case for the constructivist classroom.* Alexandria, VA: Association for Supervision and Curriculum Development.

Borg, M.G., Riding, R.J. & Falzon, J.M.(1991). Stress in teaching. A study occupational stress and its determinants, job satisfaction and carrier commitment among primary school teachers. *Educational Psychology,* 11, 59-75.

Borko, H. (1997). New form of classroom assessment. *Theory into Practice,* 36(4), 231-238.

Borko, H., & Putnum, R. T.(1995). Expanding a teacher's knowledge base: A cognitive psychological perspective on professional development. In T.R. Guskey & M. Huberman(Eds.), *Professional development in education: New paradigm and designs*(pp. 35-65). New York: Teachers College Press

Borko, H., & Putnum, R. T.(1996). Learning to teach. In R. Calfee & D. Berliner (Eds.), *Handbook of educational psychology.* New York: Macmillan.

Boyd, M.P. & Markarian, W.C. (2011). Dialogic teaching: talk in service of a dialogic stance. *Language and Education,* 25(6), 515-534, DOI: 10.1080/09500782.2011.597861

Brownlee, J., Boulton-Lewis, G., Purdie, N.(2002). Core beliefs about knowing and peripheral beliefs about learning: Developing a wholistic conceptualization of epistemological beliefs. *Australian Journal of Educational & Developmental Psychology,* 2, 1-16

Brickhouse, N.W., Bonder, G.M. & Neie, V.E. (1987). Teacher beliefs about science and their influence on classroom practice. In J. Novak (Ed.), *Proceedings of the Second International Seminer on Misconceptions and Educational Strategies in Science and Mathematics.* Vol.2. (34-48). Ithaca, NY: Cornell University.

Brosanan, P. (1994). An exploration of change in teachers' beliefs and practices during implementation of mathematics standards. (ERIC Document Reproduction Service No. ED 372949).

Brousseau, Bruce A., Book, C. & Byers, Joe L. (1988). Teachers Beliefs and the Cultures of Teaching. *Journal of Teacher Education*. Vol, 33(2). 33-39.

Brown, S.A. & Cooney, T.J. (1982). Research on teacher education: A philosophical orientation. *Journal of Research and Development in Education,* 15(4), 13-18.

Brown, S.L. & Melear, C. T.(2006). Investigation of Secondary Science Teachers' Beliefs and Practices after Authentic Inquiry-Based Experiences. *Journal of Research in Science Teaching*. Vol.43, No.9. pp. 938-962.

Bruffee, K.A. (1995). Sharing our toys: Cooperative versus collaborative learning. *Change,* 27(1), 12-18.

Bruner, J.S.(1986). *Actual minds, possible worlds.* Cambridge, MA: Harvard University Press.

Bryan, L. & Atwater, M. (2002). Teacher beliefs and cultural models: A Challenge for science teacher preparation programs. *Science education,* 86, 821-839.

Bunting, E.C.(1984). Dimensionality of teacher education beliefs: An Exploratory study. *The Journal of Experimental Education,* 52(4), 195-198.

Bybee, R. (1993). *Reforming science education- Social perspectives and personal reflections*. New York: Teachers College Press.

Calderhead, J. (1996). Teachers: Beliefs and Knowledge. In D. Berliner & R. Calfee (Eds.), *Handbook of educational psychology*, (pp. 708-725). New York: Macmillan.

Cantu, D. A. (2001). *A investigation of the relationship between social studies teachers' beliefs and practice*. Lampeter: The Edwin Mellen Press.

Carlsen, W.S. (1991). Questioning in classrooms: A sociolinguistics perspective. *Review of Educational Research,* 61, 157-178

Cazden, C. (2001).*Classroom discourse: The language of teaching and learning* (2nd ed.) Portsmouth, NH: Heinemann

Chacko, I. (1999). Teacher domination and student retardation. Proceedings of International Conference on Math Education into 21st century 1:111-119, Cairo.

Chai, C.S., Khine, M.S. & Teo, T.(2006). Epistemological beliefs on teaching and learning: a survey among pre-service teachers in Singapore. *Educational Media International,* Vol. 43, No.4, pp. 285-298

Chafi, M.E., Elkhouzai, E. & Arhlam, A. (2014). The Dynamics of Classroom Talk in Moroccan Primary School: Towards Dialogic Pedagogy. *Int. J. Edu. Res.*, Vol. 2(5), pp. 99-114

Chin, C. (2007). Teacher questioning in science classrooms: Approaches that stimulate productive thinking. *Journal of Research in Science Teaching.* 44(6), 815-843

Chin, C.(2006). Classroom Interaction in Science: Teacher questioning and feedback to students' responses, *International Journal of Science Education,* 28(11), 1315-1346

Cladue, N. J. (2014) Analysis of Teaching Approaches Used in Teaching "Science and Elementary Technology" in Rwanda: The Case of Kayonza District. Unpublished Mater's thesis, Graduate school of IDEC, Hiroshima University, Japan.

Clark, C.M., & Peterson, P. L. (1986). Teachers' thought processes. In M. Wittorck (Ed.), *Handbook of Research in Teaching* (3rd ed.) (pp. 255-296). New York: MacMillan.

Cunningham, W., Cunningham, Isabella C. M., Green, R. (1997). The Ipsative Process to Reduce Response Set Bias. *Public Opinion Q* 41 (3): 379-384. doi: 10.1086/268394.

Cohen, L., Manion, L. & Morrison, K. (2007). Research Method in Education. New York: Routledge

Cooney, T., Shaely, B., & Arvold B. (1998). Conceptualising belief structures in PSMT, *Journal for Research in Mathematics Education*, 29 (3) pp. 306-333.

Cormack, P., Wingnell, P., Nichols, S., Bills, D., & Lucas, N.(1998). Classroom discourse project: Classroom discourse in the upper primary and early secondary years: What kind of school based activity activities allow students to demonstrate achievement of out comes in talking and listening? Canberra, ACT: Department of Employment, Education, Training and Youth Affairs.

Cronin, J. (1991). Science teacher beliefs and their influence on curriculum implementation: Two case studies. *Journal of Research in Science Teaching,* 28(3), 235-250.

Czernaik, C. M. & Lumpe, A.T. (1996). Relationship Between Teacher Beliefs and Science Education Reform. *Journal of Science Teacher Education,* 7(4), 247-266.

Cornbleth, C. (2001). Climates of constraint/restraint of teachers and teaching. In W.B. Stanly (Ed.), *Critical issue in social studies research for 21st century.* Greenwich, CT: Information Age Publishing.

Darby, L. (2005). Science Students' Perceptions of Engaging Pedagogy. *Research in Science Education,* 35(4), 425-445.

Dillon, J. T. (1985). Using questions to foil discussion. *Teaching and Teacher Education,* 1, 109-121.

Das,.R.C. (1985). *Science Teaching in Schools.* Sterling Publishers Priv. Ltd. New Delhi, India.

Dawkins, K. (2004). Learners in Science: No Room on the Bench. In Weld, J. (Ed.), *The Game of Science Education* (pp.104-135), Pearson Education, Inc. United States of America.

Dewey, J. (1938). *Experience and education*, New York: Macmillan.

Edwards, D., & Mercer, N. (1987). *Common knowledge: The development of understanding in the classroom.* London, UK: Methuen.

Edwards, D., & Westgate, D.P.G. (1994). *Investigating classroom talk.* London, UK: Flamer Press.

Entwistle, N. (1990). *Handbook of Educational Ideas and Practice*, London: Routledge.

Entwistle, N. (1997). Contrasting Perspectives on Learning. In *the Experience of Learning. Implications for Teaching and Studying in Higher Education.* Marton, F., Hounsell, D. & Entwistle, W.J. (ed.), 2nd Edition, Edinburgh: Scottish Academic Press. Pp. 3.22.

Erdogan, I., & Campbell, T. (2008). Teacher questioning and interaction patterns in classrooms facilitated with differing levels of constructivist teaching practices. *International Journal of Science Education,* 30 (14), 1891-1914.

Ernest, P. (1988). The Impact of Beliefs on the Teaching Mathematics. Paper was presented as at 6th International Congress of Mathematical Education, Budapest, August.

Ernest, P. (1994). *An introduction to research methodology and paradigms. Educational Research Monograph Series,* School of Education, University of Exeter.

Evans, T. P. (1968). An Exploratory Study of the Verbal and Nonverbal Behaviors of Biology Teachers and Their Relationship to Selected Personality Traits. Unpublished PhD dissertation the Ohio State University.

Evans, T. P. (1970). *Flanders System of Interaction Analysis and Science Teacher Effectiveness*. Paper presented at the Forty-Third Annual Meeting of the National Association for Research in Science Teaching, Minneapolis, Minnesota.

Ewing, J.C., & Whittington, M.S. (2007). Types and Cognitive Level of Questions asked by Professors during College of Agriculture Class Sessions. *Journal of Agricultural Education,* vol. 48(3), 91-99.

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research*, *38*(l), 47-64.

Farquhar J. D., & Wesley, R. (2012). The Type and Timing of Feedback within an Intelligent Console-Operations Tutor. Proceedings of the Human factors and Agronomics society Annual meeting, 56(1). Retrieved from http://pro.sagepub.com/content/38/18/1225.abstract date 2013-06-07

Fischler, H. (1999). The impact of teaching experiences on student-teachers' and beginning teachers' conceptions of teaching and learning science. In J. Loughran (ed.), *Researching Teaching* (p. 172-197). London: Falmer Press.

Fishbein, M. & Ajzen, I. (1975). Belief, attitude, intention and behaviour. *An introduction to theory and research*. New York: Addison-Wesley.

Flanders, Ned A. (1970). *Analyzing Teaching Behavior*. Addison-Wesley Publishing Company, Inc. Philippines.

Fosnot, C.T. (1996). Constructivism: A Psychological Theory of Learning. In Fosnot, C.T. (eds.), *Constructivism: Theory, Perspective and Practice* (pp.8-33). New York and London.

Freeth, D. & Parker, P. (2003). Key aspects of teaching and learning in nursing and midwifery. In H., Fry, S. Ketteridge, S. & S. Marshall (Eds.), *A Handbook* of *Teaching & Learning in Higher Education, Enhancing Academic Practice. 2nd edition*, London: Kogan, pp. 324-343.

Fulton, Kathleen L. (1999). How teachers' beliefs about teaching and learning are reflected in their use of technology: Case studies from urban middle schools. Thesis submitted to the Faculty of the Graduate School of the University of Maryland, College Park in partial fulfillment of the requirements for the degree of Master of Arts.

Gall, J. P., & Gall, M.D.(1990). Outcomes of the Discussion Method. In Wilen, W.W. (eds.), *Teaching and Learning Through Discussion*. Springfield, III: Charls C. Thomas Publisher.

Gall, M.D. & Gall, J.P.(1976). The Discussion Method. In N.L. Gage (eds.), *Psychology of Teaching Methods* (pp. 166-216). 75 Yearbooks, Chicago: University of Chicago Press.

Gall, M.D. & Tom, R. (1987). Review of Research in on Questioning Techniques. In Wilen, W.W. (eds.), *Questions, Questioning Techniques, and Effective Teaching* (pp.23-48).Washington, D,C.: National Education Association.

Gall, M.D. (1970). The Use of Questions in Teaching. *Review of Educational Research*, Vol. 40. No. 5, pp. 707-721.

Galton, M.& Simon, B. (1980). *Progress and performance in the primary classroom.* London Routledge and Kegan Paul.

Gervis, M. & Capel, S.(2013). Motivating Pupils. In Capel, S., Leask, M. & Turner, T.(Eds.), *Learning to Teach in The Secondary School* (pp. 147-165). London and New York: Routledge

Glaser, B. D. & Strauss. L. (1967). *The Discovery of Grounded Theory*. Chicago: Aldine.

Goelz, L. (2004). Teacher beliefs and practices: consistency or inconsistency in the high school social studies classroom? In L.P. McCoy(Ed.), *Studies in teaching2004: Research digest.* Research Projects presented at Annual Research Forum. Wake Forest University Department of Education Winston-Salem, NC December Available at: http:// users.wfu.edu./goellj4/Research%20Draft%20Final.pdf.

Goldin, G.A.(2000). A Scientific Perspective on Structured, Task-Based Interviews in Mathematics Education Research. In Anthony E. Kelly, & Richard A. Lesh (Ed*.), Handbook of Research Design in Mathematics and Science Education* (pp. 517-545). New York, London: Routledge

Goldman, R.(2007). Video representations and the perspectivity framework: Epistemology, ethnography, evaluation, and ethics. In Goldman, R., Pea, R., Barron, B. & Derry, S.J. (Eds.), *Video research in the learning science* (pp.3-37). New Jersey: Lawrence Erlbbaum Associates, Inc.

Good, T. (1996). Teaching effects and teacher evaluation. In J. Sikula, T.J. Buttery, & E. Guyton (Eds.), *Handbook of research on teacher education* (2nded.) (pp. 617-665). New York: Simon, & Schuster/Macmillan.

Goodrum, D. (2004). Teaching Strategies for Science Classrooms. In Venville, G., & Dawson, V. (Eds.), *The Art of Teaching Science* (pp.54-72).CMO Image Printing Enterprise, Singapore.

Graesser, A.C., & Person, N. K. (1994). Question asking during tutoring. *American Educational Research Journal*, 31, 104–137.

Gregory, J. (2006). Facilitation and facilitator style. In Jarvis, P. (Eds.), *The theory and Practice of Teaching* (pp.98-113). London and New York: Routledge.

Gregory, J. (2006). Principles of experiential education. In Jarvis, P. (Eds.), *The theory and Practice of Teaching* (pp.114-129). London and New York: Routledge.

Griffin, C. (2006). Didacticism: lectures and lecturing. In Jarvis, P. (Eds.), *The theory and Practice of Teaching* (pp.73-89). London and New York: Routledge.

Guba, E.G. & Lincoln, Y. S. (1981). *Effective Evaluation*. San Francisco, Jossey-Bass, Inc. Publisher

Haney, J., Czernaik, C. & Lumpe, A. (1996). Teacher beliefs and intentions regarding the implementation of science education reform strands. *Journal of Research in Science Teaching,* 33(9), 971-993.

Haney, Jodi J., Czerniak, Charlene M. & Lumpe, Andrew T. (2003). Constructivist Beliefs about the Science Classroom Learning Environment: Perspectives from Teachers, Administrators, Parents, Community Members, and Students. *School Science and Mathematics,* 103(8), 366-377.

Haney, J. & McArthur, J. (2002). Four case studies of prospective science teachers' beliefs concerning constructivist teaching practices. *Science Education,* 86, 783-802.

Hashweh, Z. Maher (1996). Effect of Science Teachers' Epistemological Beliefs in Teaching. *Journal of Research in Science Teaching,* Vol. 33, No. 1, pp. 47-63.

Hattie, J. & Timperley, H. (2007). The power of Feedback. *Review of Educational Research.* Vol.77. No. 1, pp. 88-112

Hawkey, K. (1996). Image and the pressure to conform in learning to teach. *Teaching and Teacher Education,* 12, 47-64

Hewson, P.W. & Hewson, M.G. (1988). An appropriate conception of teaching science: A view from studies of science learning. *Science Education,* 72, 597-614.

Hoetker, W.J., & Ahlbrand, W. P. (1969). The Persistent of the Recitation. *Educational Research Journal* , 6, 145-67.

Hancock, E.S. & Gallard, A.J. (2004). Per-service science teachers' beliefs about teaching and learning: The influence of K-12 field experiences. *Journal of Science Teacher Education,* 15(4) 281-291.

Isenberg, J.P. (1990). Review of research: Teachers' thinking and beliefs and classroom practice. *Childhood Education,* 66(5), 322-327.

Jarvis, P. (2006). The Socratic method. In Jarvis, P. (Eds.), *The theory and Practice of Teaching* (pp.90-97). London and New York: Routledge.

Johsen, M. (1987). *The body in the mind: The bodily basis of meaning, imagination, and reason.* Chicago: University of Chicago Press.

Jonassen, D.H. (2000). Revisiting activity theory as a framework for designing student-centered learning environments. In D.H. Jonassen & S.M. Land (Eds.), *Theoretical Foundations of Learning Environments* (pp. 89–121). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Jones, M. G. & Carter, G.(2007). Science Teachers Attitudes and Beliefs. In Abell, S.K. & Lederman, N.G. (Eds.), *Handbook of Research on Science Education* (pp.1067-1104), Lawrence Erlbaum Associates, Publishers, Mahwah, New Jersey, London.

Joram, E. & Gabriele, A. (1998). Pre-service teacher's prior beliefs: Transforming obstacles into opportunities. *Teaching and Teacher Education,* 14(2), 175-191.

Kagan, D. M. (1992). Implications of research on teacher belief. *Educational Psychologist*, *27*, 65-90.

Kawalkar, A. & Vijapurkar, J. (2011a). Science Talk in the Inquiry Classroom: An Analysis of Teachers' Questions and Purposes. In S.Chunawala & M. Kharatmal (Eds.) proceedings of episteme 4- International Conference to Review Research on Science, Technology and Mathematics Education, p. 144-149. India: Macmillan.

Kelly, A.L. & Berthelsen, D.C. (1995). Preschool teachers' experiences of stress. *Teaching and Teacher Education,* 11(4), 45-54.

Keys, C.W. & Bryan, L.A. (2001). Co-constructing inquiry-based science with teachers: Essential research for lasting reform. *Journal of Research in Science Teaching,* 38, 631-645

Kim, J.S. (2005). "The Effects of a Constructivist Teaching Approach on Student Academic Achievement, Self-concept, and Learning Strategies", *Asia Pacific Education Review*, No. 6 (1), pp. 7-19.

Knowles, J. G. (1992). Models for understanding pre-service and beginning teachers' biographies: Illustration from case studies. In I.F. Goodson (Ed.) *Studying teachers' lives* (pp.99-152). London, Rutledge.

Knowles, M. (1978). *The Adult Learner: A neglected Species* (2nd edn), Gulf Publishing Co, Houston.

Koballa, T., Graber, W., Coleman, D.C. and Kemp, A.C. (2000). Prospective gymnasium teachers'' conceptions of chemistry learning and teaching. *International Journal of Science Education*, 22(2), 209-224.

Kuhn, T. S. (1970). *The structure of scientific revolutions.* Chicago: University of Chicago Press.

Kulhavey, R.W. (1977). Feedback in written instruction. *Review of Educational Research*, 47(1), 211-232.
Lederman, N.G. (1992). Students' and Teachers' conceptions of the Nature of Science: A review of the research. *Journal of Research in science Teaching*, 29(4), 331-359.
Lemke, J.L. (1990). *Talking Science: Language, learning and values.* Norwood, NJ: Ablex.
Levitt, K. (2002). An Analysis of Elementary Teachers' Beliefs Regarding the Teaching and Learning of Science. *Science Education,* Vol. 86, p. 1-22.
Loucks-Horsley, S., Hewson, P. W., Love, N., & Stiles, K. (1998). *Designing professional development for teachers of science and mathematics*. Thousand Oaks, CA: Sage.
Luft, J.A. (1999). Teachers' salient beliefs about a problem solving demonstration classroom in-service program. *Journal of Science Teacher Education,* 36(2), 141-158.
Lortie, D. (1975). *Schoolteacher: A sociological study.* Chicago: University of Chicago.
Lyle, S. (2008). Dialogic Teaching: Discussing Theoretical Contexts and Reviewing Evidence from Classroom Practice. *Language and Education*, Vol.22, No. 3, pp.222-240.
Malcolm Carr, Miles Barker, Beverley Bell, Fred Biddulph, Alister Jones, Valda Kirkwood, John Pearson & David Symington (1994). The Constructivist Paradigm and Some Implications for Science Content and Pedagogy. In Fensham, Peter J., Gunstone, Richard F., White, Richard T.(Eds.), *The Content of Science A constructivist Approach to its Teaching and Learning*(pp. 147-160). Routledge Falmer, London.
Mansour, N. (2008b). *Models of Understanding Science Teachers' Beliefs and Practices: Challenges and Potentials for Science Education.* VDM Verlag Dr. Mueller e.K.
Mansour, N. (2009). Science Teachers' Beliefs and Practices: Issues, Implications and Research Agenda. *International Journal of Environmental & Science Education,* Vol. 4, No. 1, pp. 25-48
Mansour, N.(2008a). The experiences and personal religious beliefs of Egyptian science teachers as a framework for understanding the shaping and reshaping of their beliefs and practices about science-Technology and Society (STS). *International Journal of Science Education,* 30(12), 1605-1634.
Maor, D. & Taylor, P.C.(1995). Teacher epistemology and scientific inquiry in computerized classroom environments. *Journal of Research in Science Teaching,* 32(8), 839-854.
Markic, S. & Eilks, I.(2010). A Mixed Method Approach to Characterise the Beliefs on Science Teaching and Learning of Freshman Science Student Teachers from Different Science Teaching Domains. In M.F. Tasar & G. Cakmakci (Eds.), *Contemporary science education research: Teaching* (pp. 21-28). Ankara, Turkey: Pegem Akademi.
Marzano, R.J. (2007). *The art and science of teaching: A comprehensive framework for effective instruction*: Ascd.
Maxion, S.P. (1996). *The influence of teachers' beliefs on literacy development for at-risk first grade students.* Paper presented at the annual meeting of the American association of colleges for teacher education. 48th, Chicago, IL, February 21-24. (ERIC Document Reproduction service No. ED 392780).
McCormick, J. & Leask, M. (2005). Teaching Styles. In Susan, C., Leask, M. & Turner, T. (Eds.), *Learning to Teach in the secondary School* (pp. 276-291). London and New York: Routledge.
McGillicuddy-De Lisi, A. V., & Subramanian, S. (1996). How do children develop knowledge? Beliefs of Tanzanian and American mother. In S. Harkness & C. M.Super

(Eds.), *Parents' cultural belief systems: their origins, expressions, and consequences* (pp. 143-168). New York: the Guiford Press.

McIntosh, N. (1995). Religion-as-Schema, with implication for the relation between religion and coping. *The International Journal for the Psychology of Religion, 5* (1), 1-16.

Mehan, H. (1979). *Learning lessons.* Cambridge, MA: Harvard University Press.

Mellado, V. (1998). The classroom practice of preservice teachers and their conceptions of teaching and learning science. *Science Education,* 82(2). 197-214.

Mercer, M., & Littleton, K. (2007). Dialogue and the development of Children's thinking: A sociocultural approach. New York: Routledge.

Mezirow, J. (1991). *Transformative Dimensions of Adult Learning,* Jossey-Bass, San Francisco, CA

Miles, M.B., & Huberman, A.M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook.* (2nd Edition). Thousand Oaks, Calif.: Sage.

Miller, K. & Zhou, X.(2007). Learning from classroom video: What makes it compelling and what makes it hard. In Goldman, R., Pea, R., Barron, B. & Derry,. S.J. (Eds.), Video research in the learning sciences (pp. 321-334). New Jersey: Lawrence Erlbaum Associates, Inc.

Ministry of Education [MOE]. (2003). Draft Final Report: Teaching Quality Improvement in Secondary Education project (TQI-SEP), ADB TA No. 3901-BAN. Vol. 1, No. 3.

Ministry of Education [MoE]. (2004). National Education Commission-2003. Report, Dhaka, Government of Bangladesh.

Ministry of Education [MoE]. (2006). B.Ed Curriculum: Secondary Teacher Education. Dhaka, Government of Bangladesh.

Ministry of Education [MoE]. (2008). Teaching Science: Training Manuel, Module 4 & 5. Dhaka, Bangladesh. Teaching Quality Improvement in Secondary Education project, Education Building (2nd Block), Dhaka.

Ministry of Education [MoE]. (2009). National Education Policy 2010. Dhaka, Government of Bangladesh.

Mortimer, E.F., & Scott, P.H. (2003). *Meaning Making in Secondary Science Classrooms.* Maidenhead, UK: Open University Press.

Munby, H., Cunningham, M., & Lock, C. (2000). School science culture: A case study of barriers to developing professional knowledge. *Science Education,* 84, 193-211. doi:10.1002/(SICI)1098-237X(200003)84:2<193::AID-SCE4>3.0.CO;2-K.

Muskin, C. (1990). Constraint of teaching methods and opportunity to learn in high school history classes. Paper presented at the Annual Meeting of the American Educational Research Association, Boston, MA. (ERIC Document Reproduction Service No. ED322038).

Myhill, D. (2006). Talk, talk, talk: teaching and learning in whole class discourse. *Research Papers in Education*,Vol. 21, No. 1

Myhill, D., & Dunkin, F.(2005). Questioning Learning. *Language and Education,* Vol. 19, No. 5

National Research Council [NRC]. (1996). National Science Education Standards. Washington DC: National Research Council.

Nelleke, A.H. Belo, Jan. H. Van Driel and Nico Verloop (2010). Teachers' beliefs about making physics engaging and comprehensible for secondary students in the

Netherlands. In M.F. Tasar & Cakmakcl (Eds.) *Contemporary science education research: teaching* (pp.29-39. Ankara, Turkey: Pegem Akademi.

Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies*, 19(4), 317-328.

Newman, D., Griffin, P., & Cole, M.(1989). *The construction zone: Working for cognitive change in school.* Cambridge, UK: Cambridge University Press.

Niehaus, B., & Vogt, H. (2005). Dimensionen zur Beschreibung verschiedener Biologielehretypen auf Grundlage ihrer Einstellungen zum Boilogieunterricht. *Zeitschrift fur Didaktik der Naturwissenschaften,* 11, 73-84.

Nuthall, G. A. (1999a,). How students learn: The validation of a model of knowledge acquisition using stimulated recall of the learning process. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal.

National Center for Educational Statistics (1999). *What happens in classrooms? Instructional practices in elementary and secondary schools 1994-95*(NCES 1999-348).

OECD (2009) Creating Effective Teaching and Learning Environments: First Results from Talis. OECD publications

Okebukola, P.A. & Jegede, O.J. (1992). Survey of factors that stress science teachers and examination of coping strategies. *Science Education,* 76(2), 199-210.

Olson, J.K.(1988). *School world/micro-worlds: Computers and culture of the school*. Pergamon, Press, Inc., Elmsfold, NY.

Osborne, J., Simon, S. & Collins, S. (2003). Attitudes towards science: a review of the literature and its implications. *International Journal of Science Education* 25, 1049-1079.

Osborne, R.J. and Freyberg, P. F.(1985). *Learning in Science; the Implications of Children's Science*. Auckland: Heinemann.

Pajares, M. F. (1992). Teachers' Beliefs and Educational Research : Cleaning Up a Messy Construct, *Review of Educational Research*, *62*(3), 307–332.

Parakh, Jal S. (1965). A Study of Teacher-Pupil Interaction in High School Biology Classes. Unpublished PhD dissertation, Cornell University.

Pedersen, S. & Liu M. (2003). Teachers' Beliefs about Issues in the Implementation of a Student-Centered Learning Environment. *ETR&D,* Vol. 51, No. 2, pp. 57–76 ISSN 1042–1629.

Poulson, L., Avramidis, E., Fox, R., Medwell, J., & Wary, D. (2001). The theoretical orientation of primary school literacy teachers: an exploratory study. *Research Paper in education,* 16(3), 271-292.

Pimentel, D. S. & McNeill, K. (2013). Conducting Talk in Secondary Science Classrooms: Investigating Instructional Moves and Teachers' Beliefs. *Sci.Edu*, Vol. 97: 367-394

Prawat, S. (1992). Teachers' Beliefs about Teaching and Learning: A Constructivist Perspective. *American Journal of Education*, Vol. 100, No. 3, pp. 354-395

Preece, J. & Griffin, C. (2006). Radical and feminist pedagogy. In Jarvis, P. (Eds.), *The theory and Practice of Teaching* (pp.53-70). London and New York: Routledge.

Rahmat, B.R. (2013). Peer Feedback: A Case Study of Assessment for Learning in a Singaporean Classroom. *GSE Journal of Education,* Vol.1, p. 64-87

Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula, T.J. Buttery, & E. Guyton (Eds.), *Handbook of research on teacher education* (2nded.) (pp. 102-119). New York: Simon, & Schuster/Macmillan.

Richmond, G., & Anderson, C. (2003). *The nature of tensions between educator and teacher candidate beliefs about science teaching practice*. Paper presented at the National Association for Research in Science Teaching, Philadelphia.

Robinson, M., & McMillan, W.(2006). Who teaches the teachers? Identity, discourse and policy in teacher education. *Teaching and Teacher Education,* 22, 327-336.

Roehrig, G.H., & Kruse, R.A. (2005). The role of teacher' beliefs and knowledge in the adoption of a reform-based curriculum. *School Science and Mathematics,* 105(8), 421-422.

Rogers, C. (1969). *Freedom to Learn*, Merrill, Columbus, OH

Rokeach, M. (1968). *Beliefs, attitudes, and values: A theory of organization and change*. San Francisco: Jossey-Bass

Roschelle, J. (2000). Choosing and Using Video Equipment for Data Collection. In Anthony E. Kelly, & Richard A. Lesh (Ed.*), Handbook of Research Design in Mathematics and Science Education* (pp.709-731). Routledge, Taylor& Francis Group, New York, London.

Roth, W.M. (1996). Teacher questioning in an open-inquiry learning environment: Interactions of context, content, and student responses. *Journal of Research in Science Teaching*, 33(7), 709–736.

Sadler, R. (1989). Formative assessment and the design of instructional systems. *Instructional science,* 18, 119-144

Samuelowicz, K., & Bain, J. D. (2001). Revisiting academics' beliefs about teaching and learning, *Higher Education* 41: 299–325.

Savasci-Acikalin, F.(2009). Teacher Beliefs and Practice in Science Education. *Asia-Pacific Forum on Science Learning and Teaching,* Vol. 10, No.1. article 12.

Scheerens, J. and R.J. Bosker (1997), *The Foundations of Educational Effectiveness*, Pergamon, Oxford.

Schommer-Aikins, M. & Easter, M. (2006) Ways of knowing and epistemological beliefs: combined effect on academic performance, *Educational Psychology,* 26(3), 411–423.

Schön, D. (1983). A reflective practitioner. How professionals think in action. New York: Basic Books

Schwab, J.J. (1958). The Teaching of Science as inquiry. *Bulletin of the Atomic Scientists,* 14, 374-379.

Scott, C. (2009). Talking to learner: Dialogue in the classroom. *The Digest,* NSWIT, 2009(2). Retrieved 13 July, 2013 from http://www.nswteachers.nsw.edu.au

Scott, P. (1998). Teacher talk and meaning making in science classrooms: A Vygotskian analysis and review. *Studies in Science Education*, 32: 1, 45-80.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching: *Educational Research,* 15(2), 4-14.

Shulman, L.S. (1987). Knowledge and teaching: Foundation of the new reform. *Harvard Educational Review*, 57(1), 1-22.

Siddiquee, M. N.-E.-A., & Ikeda, H. (2013b). Science Teachers' Beliefs on Teaching and Learning at Secondary Schools in Bangladesh. *GSE Journal of Education*, 37-63.

Simmons, P. E., Emory, A., Carter, T., Coker, T., Finnegan, B., Crockett, D., et al. (1999). Beginning teachers: Beliefs and classroom actions. *Journal of Research in Science Teaching, 36*(8), 930-954.

Sinclair, J., & Coulthard, M. (1975). Towards an analysis of discourse. London: Oxford University Press.

Smith, E.L., Blakeslee, T. D., & Anderson, C.W. (1993). Teaching strategies associated with conceptual change learning in science. *Journal of Research in Science Teaching*, 20, 111-126.

Staub, F. and E. Stern (2002), "The Nature of teachers' Pedagogical Content Beliefs Matters for Students' Achievement Gains: Quasi-experimental Evidence from Elementary Mathematics", *Journal of Educational Psychology*, No. 93, pp. 144-155.

Stipek, Deborah J, Karen B. Givvin, Julie M. Salmon, Valanne L. MacGyvers (2001). Teachers' beliefs and practices related to mathematics instruction. *Teaching and Teacher Education,* 17, 213-226.

Strauss, A. & Corbin, J. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. London, Saga Publication.

Swift, J. N., Gooding, C.T., & Swift, P. R., (1988). Questions and wait time. In J. T. Dillon (Ed.), *Questioning and discussion: A multidisciplinary* study (pp.192-211). Norwood, NJ. Ablex.

Taylor, Peter C. (1998). Constructivism: Value Added. In B.J. and K.G. Tobin *(*eds.), *International Handbook of Science education,* (pp.1111-1123), Kluwer Academic Publishers. London.

Teaching Quality Improvement in Secondary Education Project [TQI-SEP]. (2009). School Monitoring Compilation Report, Consultants, Component 3.

Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp.127-146). New York: Macmillan.

Tight, M. (2002). *Key Concepts in Adult Education and Training* 2nd Edition. New York, London: Routledge

Tobin, K.(2000). Interpretive Research in Science Education. In Anthony E. Kelly, & Richard A. Lesh (Ed*.), Handbook of Research Design in Mathematics and Science Education* (pp. 487-512). Routledge, Taylor& Francis Group, New York, London.

Tobin, K., Tippins, D.J., & Gallard, A.J. (1994). Research on instructional strategies for teaching science. In Dorothy L. Gable (Ed*.), Handbook of research on science teaching and learning* (pp. 45-93). New York: National Science Teachers Association.

Tobin, K. & Fraser, B. J. (1990). What does it mean to be an exemplary science teacher? *Journal of Research in Science Teaching,* 27, 1, 3-25.

Tobin, K. (1987). The role of wait time in higher cognitive level learning. *Review of Educational Research,* 57, 69-95.

Tough, A. (1979). *The Adult's Learning Projects: A Fresh Approach to Theory and Practice in Adult Learning* (2nd edn), Ontario Institute for Studies in Education, Toronto

Trochim, W.M.K. & Donnelly, J.P. (2008). The Research Methods Knowledge Base. USA

Tsai, Chin-Chung (2002). Nested epistemologies: Science teachers' beliefs of teaching and learning. *International Journal of Science Education,* vol. 24, no. 8, 771-783

Uzunttiryaki, E. , Boz, Y., Kirbulut, D., & Bektas, O. (2010). Do Pre-service Chemistry Teachers Reflect their Beliefs about Constructivism in their Teaching practices? *Res.Sci. Educ*, 40:403-424

Vaiteka, S. & Fernandez, C. (2010). Curriculum and Teaching Ideas of pre-service Chemistry Teachers in a Context of Educational Reform in Brazil. In M.F. Tasar & G. Cakmakci (Eds.), *Contemporary science education research: Teaching* (pp. 13-19). Ankara, Turkey: Pegem Akademi.

Van Zee, E.H., & Minstrell, J. (1997a). Reflective discourse: Developing shared understandings in a physics classroom. *International Journal of Science Education*, 19(2), 209-228

Van Zee, E.H., & Minstrell, J. (1997b). Using questioning to guide student thinking. *The Journal of the Learning Sciences*, 6 229-271.

Vargas, M.P.B. & T. van Andel. (2005). The use of hemiepiphytes as craft fibers by indigenous communities in the Colombian Amazon. *Ethnobotany Research and Applications* 3:243-260.

Veeman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research,* 54, 143-178.

Verjovsky, J. & Waldegg, G. (2005). Analyzing Beliefs and Practices of Mexican High School Biology Teacher. *Journal of Research in Science Teaching,* Vol. 42, No. 4, pp. 465-491.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wehling, L. & Charters, W. (1969). Dimensions of teacher beliefs about teaching process. *American Educational Research Journal,* 6(1), 7-29.

Weimer, M. (2002). *Learner-Centered Teaching: Five Key Changes to Practice*. San Francisco: Jossey Bass.

Wellington, J., & Osborne, J. (2001). Talk of the classroom: Language instructions between teachers and pupils. In J. Wellington & J. Osborne (Eds.), *Language and literacy in science education* (pp. 24-40). Buckingham, UK: Open University Press.

Wells, G. (1993). Reevaluating the IRF sequence: A proposal for the articulation of theories of activity and discourse for the analysis of teaching and learning in the classroom. *Linguistics and Education,* 5, 1-37.

Welmond, M.(2002). Globalization viewed from the periphery: the dynamics of teacher identity in the Republic of Benin. *Comparative Education Review,* 46(1), 37-65.

Wetzel, David R. (2004). Technology Transform the Game of Science Teaching. In Weld, J. (Ed.), *The Game of Science Education* (pp.254-287), Pearson Education, Inc. United States of America.

Wilen, W.W. (1988). Review of Pedagogical Perspectives. In J.T. Dillon (eds.), *Questions and Questioning: A Multidisciplinary Study*. Norwood, N.J.: Ablex

Wilen, W.W. (1991). *Questioning skills, for teachers.* (3rd ed.). Washington, D.C.: National Education Association.

Winne, P.M. & Butler, D.L. (1994). Student cognition in learning from teaching. In T. Husen & T. Postlewaite (Eds.), *International encyclopedia of education* (2nd ed., pp. 5738-5745). Oxford, UK: Pergamon.

Wood, D., & Wood, H. (1988). Questioning vs. Student Initiative. In J.T. Dillon (eds.), *Questioning and Discussion: A Multidisciplinary Study* (pp.280-305). Norwood, N.J.: Albex.

World Bank (2013). Bangladesh Education Sector Review Seeding Fertile Ground: Education That Works for Bangladesh. Report No. 80613-BD

Woolley, Sandra L., Benjamin, Woan-Jue J & Woolley, Anita W. (2004). Construct Validity of a self-reported Measure of Teacher Beliefs Related to Constructivist and Traditional Approaches to Teaching and Learning. *Educational and Psychological Measurement*, Vol. 64, No. 2, 319-331.

Yang, F. Y., Chang, C.Y. & Hsu, Y.S. (2008). Teacher views about constructivist instruction and personal epistemology: a national study in Taiwan. *Educational Studies,* Vol.34 (5), pp. 527-542

Yin, R. (1994). Case Study Research: Design and Methods, second edition, Thousand Oaks, CA: Sage.

Yip, D.Y. (2004). Questioning skills for conceptual change in science instruction, *Journal of Biology Education*, 38, 76-83.

Zohar, A., & Aharon-Kravertsky, S. (2005). Exploring the effects of cognitive conflict and direct teaching for students of different academic level. *Journal of Research in Science Teaching,* 42(7), 829-855.

Zipf, R., & Harrison, A. (2003). *The terrarium unit: A challenge to teachers' concepts of what is science teaching.* Paper presented at the American Educational Research Association Annual Meeting, Chicago

APPENDICES

Appendix A

Teacher Beliefs questionnaire (*Bengali version*)

শিক্ষকদের জন্য প্রশ্নমালা

সম্মানিত উত্তরদাতা

নিম্নোক্ত বিষয়ে একটি প্রাথমিক অনুসন্ধান পরিচালনার জন্য আপনার সহযোগিতা কামনা করছি ।

“বাংলাদেশের মাধ্যমিক বিদ্যালয়ের বিজ্ঞান শিক্ষকদের বৈজ্ঞানিক জ্ঞান এবং বিজ্ঞান শিক্ষণ সম্পর্কিত বিশ্বাস” প্রশ্নমালাটি পূরণ করে আমাকে সহযোগিতা করার জন্য আপনাকে ধন্যবাদ ।

প্রশ্নমালা সম্পর্কে সাধারণ নির্দেশনা

এই প্রশ্নমালাটি দুটি অংশে বিভক্ত: ক ও খ

- ✓ **ক অংশ**- সাধারণ তথ্য সম্পর্কিত
- ✓ **খ অংশ**- বিজ্ঞান শিক্ষকদের বিজ্ঞান সম্পর্কিত জ্ঞান এবং বিজ্ঞান শিক্ষণ সম্পর্কিত কিছু প্রশ্ন সম্বলিত

প্রশ্নমালাটি পূরণ করতে আনুমানিক ২৫ মিনিট সময় লাগবে। প্রতিটি প্রশ্নের উত্তর দানের ক্ষেত্রে প্রয়োজনীয় নির্দেশনাসমূহ বাঁকা হরফে লেখা হয়েছে এবং আপনার সুচিন্তিত মতামত *ক্রস (✕) চিহ্নের* মাধ্যমে প্রদান করুন ।

গোপনীয়তা

এ গবেষণার জন্য গৃহীত সকল তথ্য গোপন বলে গণ্য হবে। আপনাকে আশ্বস্ত করা হচ্ছে যে এই গবেষণার ফলাফল যেখানেই প্রকাশ করা হোক না কেন এটিতে আপনি, আপনার বিদ্যালয় কিংবা সংশ্লিষ্ট সকলের পরিচয় গোপন রাখা হবে। গবেষণাকর্মে আপনার অংশগ্রহণ স্বেচ্ছাসেবী এবং আপনি যে কোন সময় অংশগ্রহণ করা থেকে নিজেকে বিরত রাখতে পারেন ।

ক: সাধারন তথ্য

নিম্নের প্রশ্নগুলো আপনি, আপনার শিক্ষাগত যোগ্যতা ও শিক্ষকতাকর্মে আপনার ব্যয়িত সময় সম্পর্কিত । এই প্রশ্নগুলোর উত্তর দানের বেলায় অনুগ্রহ করে সঠিক ঘরে ক্রস (✕) চিহ্ন দিন ।

১. লিঙ্গ?

পুরুষ ☐ মহিলা ☐

২. বয়স?

২৫ এর কম ☐ ২৫-২৯ ☐ ৩০-৩৯ ☐ ৪০-৪৯ ☐ ৫০-৫৯ ☐ ৬০+ ☐

৩. স্নাতক পর্বে অধীত বিষয় *অনুগ্রহকরে একটি ঘর চিহ্নিত করুন*

☐ পদার্থ ☐ রসায়ন ☐ জীববিজ্ঞান

৪. ইনসার্ভিস ট্রেনিং/ চাকুরীকালীন সময়ে প্রাপ্ত প্রশিক্ষণের নাম- B.Ed. ☐ SBC ☐
TQI ☐ CPD ☐ OT ☐

৫. আপনি কতদিন যাবৎ শিক্ষকতা করছেন?
☐ এটি আমার চাকুরী জীবনের প্রথম বছর ☐ ১-২ বছর ☐ ৩-৫ বছর

☐ ৬-১০ বছর ☐ ১১-১৫ বছর ☐ ১৬-২০ বছর ☐ ২০ বছরের বেশি

৬. *নিচে শিক্ষণ-শিখন সম্পর্কে কিছু উক্তি আছে।*
(অনুগ্রহকরে আপনার মতামত ক্রস চিহ্নের (✕) মাধ্যমে প্রদান করুন)

অংশ খ: বৈজ্ঞানিক জ্ঞান, শিক্ষণ-শিখন, বিশ্বাস ও মূল্যবোধ

বাক্য	সম্পূর্ণ দ্বিমত	দ্বিমত	একমত	সম্পূর্ণ একমত
ক) দক্ষ শিক্ষক কোন একটি সমস্যা সমাধানের সঠিক পথ নির্দেশ করেন।				
খ)কোন কাজের সিদ্ধান্ত গ্রহণে শিক্ষার্থীদের তুলনায় শিক্ষকের মতামত বেশি গুরুত্বপূর্ণ।				
গ) শিক্ষক হিসেবে আমার দায়িত্ব হল শিক্ষার্থীদের জানার আগ্রহকে উৎসাহ প্রদান করা।				
ঘ) শিক্ষক সরাসরি কোন প্রশ্নের উত্তর দিবেন না বরং শিক্ষার্থীর নিকট থেকে উত্তর (ভুল বা শুদ্ধ) বের করার চেষ্টা করবেন।				
ঙ) কার্যকর শিখন তখনই হয় যখন শিক্ষার্থীরা নিজেরা নিজেদের সমস্যার সমাধান খুজে বের করে।				
চ) শ্রেণী শিক্ষকের যথাযথ নির্দেশনা শিক্ষার্থীদের সমস্যা সমাধানে কার্যকর ভূমিকা পালন করে।				
ছ)শিক্ষার্থীরা কতটুকু শিখবে তা নির্ভর করে তাদের পূর্বে অর্জিত জ্ঞান কতটুকু তার উপর। এই কারণে শিক্ষণে পূর্বজ্ঞান যাচাই করা খুবই জরুরি।				
জ) কোন বাস্তব সমস্যার সমাধানের বেলায় শিক্ষক সরাসরি সমাধানের পথ দেখিয়ে না দিয়ে বরং তার পূর্বে শিক্ষার্থীদেরকে চিন্তা করতে দেয়া উচিত।				
ঝ)কার্যকর শিখনের জন্য সাধারনত একটি কোলাহলমুক্ত শ্রেণীকক্ষ দরকার।				
ঞ) পাঠ্যবইয়ের সুনির্দিষ্ট বিষয়বস্তুর তুলনায় কোন বিষয় সম্পর্কে ভাবনা এবং ভাবনার কারন অনুসন্ধানের (thinking and reasoning) প্রক্রিয়া বেশি গুরুত্বপূর্ণ।				

আপনার সহযোগিতার জন্য অশেষ ধন্যবাদ!!!!!

Appendix B

Teacher Beliefs questionnaire

Direct transmission(traditional) beliefs about teaching

- Effective/good teachers demonstrate the correct way to solve a problem
- Instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly
- How much students learn depends on how much background knowledge they have – that is why teaching facts is so necessary
- A quiet classroom is generally needed for effective learning
- It is better when the teacher – not the student – decides what activities are to be done.

Modern beliefs about teaching

- My role as a teacher is to facilitate students' own inquiry
- Students learn best by finding solutions to problems on their own
- Students should be allowed to think of solutions to practical problems themselves before the teacher shows them how they are solve
- Thinking and reasoning processes are more important than specific curriculum content
- I ask my students to suggest or to help plan classroom activities or topic plan classroom activities or topic

Adapted from OECD,2009

Appendix C

Interview Schedule for science teachers

Demographic and Background information

Take note of the following

- Date:________________________________
- Sex:________________________________
- Place:________________________________
- Interviewee's name:_____________________________
- Teaching experience:____
- Subject taught:____
- In-service training:____

Section A

My Name is Muhammad Nur-E-Alam Siddiquee, I am a PhD student at the graduate school for International Development and Cooperation, Hiroshima University, Japan. Holding ID no. D114545. The title of my research is: **EXPLORING BELIEFS ON TEACHING-LEARNING AND ACTUAL PRACTICES: A CASE OF SECONDARY SCHOOL SCIENCE TEACHERS IN BANGLADESH**

- The purpose of the study is to illustrate the science teachers' beliefs on teaching and learning and their actual practices in Bangladesh**.**
- All information gathered through this interview will be used exclusively for the purpose of research and anonymity of respondents will firmly be ensured. You are guaranteed that neither you, this school nor any of its personnel will be identified in any report of the results of the study.

Section B

1 In which approach or strategy do you think that science should be taught?

2. Could you describe what an ideal science teaching environment would look like?

3. What do you think teachers should do for effective learning?

4. What are the best ways to learn science? Explain your ideas.

5. What do you think about responsibilities of student when learning science?

6. What should teacher focus on teaching "presenting facts (definition, theory, process, concepts, etc.) or students' individual development of thinking and reasoning"? Please explain your idea/s with reasoning.

Thank You Very Much for Your Nice Cooperation!!!!!!

Appendix D

Check list for determining teaching style

Nam of Observer:
Date and Time:
Teachers:
Grade level and /or Subject:
Objective of observation: To determine the teaching style of a particular teacher.
Instruction to the observer: Prior to the observation, read over the items below. This item represents various teaching styles used by teachers. During and after the observation, place a" ×" next to those items you have observed.

Disposition statement	Observed	Remarks
State learning goals		
Review students homework they have prepared		
present a short summary of the previous lesson		
Check students' exercise books		
Check, by asking questions, whether or not the subject matter has been understood		
Students **work in small groups** to come up with a joint solution to a problem or task.		
Students **help to plan classroom** activities or topics		
Students **evaluate and reflect upon** their own work		
Students work in groups based upon their abilities		
Students **work on projects** that require at least one week to complete		
Students **make a product** that will be used by someone else		
Ask students to **write an essay** in which they are expected to explain their thinking or reasoning at some length		
Students **hold a debate** and argue for a particular point of view which may not be their own		

Adapt from OECD, 2009

Appendix E

Letter of Permission

HIROSHIMA UNIVERSITY

IDEC

To Whom It May Concern:

30 October 2012

Dear Sir/Madam,

I am writing for asking your permission to allow Mr. MUHAMMAD NUR-E-ALAM SIDDIQUEE to conduct his research at your school.

Mr. MUHAMMAD NUR-E-ALAM SIDDIQUIEE is a PhD student at the Graduate School for International Development and Cooperation (IDEC), Hiroshima University, Japan. For his doctoral dissertation, he plans to conduct research on "**SCIENCE TEACHERS' BELIEFS AND ACTUAL PRACTICES ABOUT TEACHING AND LEARNING AT SECONDARY SCHOOLS IN BANGLADESH**". Since Secondary Teacher Education Curriculum of Bangladesh firmly stands modern beliefs about teaching, it is timely to investigate Bangladeshi teachers' beliefs regarding science teaching and learning to see if these beliefs coincide with the intentions of the most recently introduced curriculum.

According to the nature of this study, data sources from secondary school teachers in some selected schools, located in Dhaka city in Bangladesh will be the primary target. To collect the data, he is going to use the video recorder to capture actual classroom teaching as well as the interview schedule. As there is no researcher has been conducted yet regarding teachers' beliefs and practices in Bangladesh, therefore, I believe, this study will provide a deep insight about teachers' beliefs and practices to the teachers, teacher educators, and curriculum developers of Bangladesh.

This letter is therefore, issued to him, and used for asking permission from the Ministry of Education of Bangladesh and other involvements, in line with this research purpose only.

Sincerely yours

Hideo Ikeda

IKEDA Hideo
Professor
Graduate School for International Development and Cooperation (IDEC)
Hiroshima University, Japan

Appendix F

A part of sample verbatim lesson transcript along with coding by using Flanders system

Verbal exchange	Code symbol
T (Teacher): look at your textbook and open page 48. (1)	6
Look on the board and draw the picture (2)	6
Do you know the name of the picture? (3)##	4
Ss (Students): T2 virus (4)	8
T; look at the shape of its head.(5)	6
What is its head shape? (6)	4
S (student): no response# (7)	10
T: What is the shape of it head? (8)	2
S: No response## (9)	10
T: shape is hexagonal. (10) It means six arm, 1, 2, 3, 4, 5, & 6. (11)	5, 5
Total body of a T2 virus consists of (12) two components: head and tail (13).	5,5
The whole body composed of protein cover. (14)	5
Of its head there is cavity (15).	5
Within the cavity there is a double stand DNA (16)	5
S: is there any other shape beside hexagonal? (17)	9
T: What are other parts of it? (18)	4
S: tail, spike, base plate (19)	8
T: tail, spike, base plate (20)	2
Hello, don't talk (21).	6
I will ask you few minutes later. (22)	7
And then all of you should say. (23)	7
Now close your book. (24)	6
Can you tell me? (25) the body of T2 virus composed of what?(26)	4, 4
Ss: Protein (27)/ cellulose	8

T: protein (28). 2

How many parts of body does it have? (29) 4
S: two (30) 8

T: Good! (31) What is the name of those two parts? (32) 2, 4
S: Head and Tail. (33) 8
T: head and tail (34). 2

Inside the head there is cavity (35) that contains Nucleic acid. (36) 5,5

What is inside of the cavity of virus?, 4

S: Nucleic acid. 8

T: There are two kind of nucleic (37) acid: RNA and DNA. (38)## 5,5

Animal virus usually contains DNA (39) and Plants virus contains RNA (40).

But there is exception. E.g HIV (42) 5, 5,5

TMV is a typical Plant virus (43) while T2 virus is an Animal virus (44). 5, 5

Is there any difference between DNA and RAN? (45). 4

Ss: No Sir##(46) 8

T: DNA is Double standard (47) but RNA is Single standard,(48) 5,5

Not only that the sugar molecule (49) of both Nucleic acid is different. (50) 5, 5

This nucleic acid is the main component (51) of the virus by which it can infect (52) 5, 5

other plants or animals (53)and cause disease.(54)### 5,5

There are many plants and animals (55) diseases caused by virus.(56) 5,5

Plant diseases like tobacco mosaic (57) disease, bean mosaic diseases,(58) 5,5

tomato vein cleaning disease, etc(59). Influenza, small fox, ham, etc,(60) are some 5,5

the example of human diseases(61). Beside human being virus causes (62) 5, 5

many diseases in animals.(63) Cowpox, Ranikhet, Parrot fever, etc. (64) 5,5

there is no medicine for viral diseases.(67)So we have to be very careful 5

about virus (68).

How do viruses spread in the environment? 4

S: I don't know. 8

T; We have to know the process of virus spreading (69). 5,5

Virus can spread in many ways.(70) Through coughing, touching (72) 5,5

with virus infected people(73), using the cloth of virus infected people(74), ,55

Through blood, etc. (75) Washing hand frequently cans (76) help prevent transmission 5.5

Of (77) illness from infected people (78). If you shake hands with someone (79) 5,5,5 with a cold, who has just wiped (80) his nose or coughed he could transmit(81) 5,5

that virus to you. If you then touch (82) your eyes or nose you could become infected. (83) 5,5

Next class I will take a class test on it (T2) (84). 5

So get ready for the class test.(85) 6

How do you keep yourself protected from virus infection? Can you? Think about it I will discuss it later.

An example of making tallies by using code symbol with a real lesson topic: Virus

Code symbol	Tally of times observed	Total tallies/frequency	percent
1		0	00
2	iiiii	5	6.2
3		0	00
4	iiiii iii	8	9.88
5	iiiii iiiii iiiii iiiii iiiii iiiii iiiii, iiiii, iiiii, iiiii i	51	62.95
6	Iiiii i	6	7.40
7	ii	2	2.47
8	iiiii i	6	7.40
9	i	1	1.23
10	ii	2	2.47
Total		81	100