

Exploring Science Teachers' Belief towards Inquiry Based Teaching Learning Activity at Grade –VI

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ABSTRACT

The National Curriculum of Bangladesh (2012) recommends student-centric IBT (IBT) learning activities in the science classroom. However, teaching science in Bangladesh hardly follows the instructions of curriculum, and most teachers are found not to place adequate emphasis on involving the students in the inquiry process. A possible reason might be science teachers' belief. The focus of the research questions is to find out firstly, the beliefs of both urban and rural sixth grade science teachers and secondly, the differences between genders and lastly to explore the challenges of IBT. Thereby, a sequential explanatory mixed method was adopted for this study. The participating teachers were from both rural and urban areas. An interview was taken to support statistical and quantitative data for an in-depth explanation. The result revealed that teachers from both urban and rural areas have positive beliefs towards inquiry, and there is no significant difference between urban-rural and male-female teachers. In the case of urban teachers, the challenges were time and classroom management, but not for rural teachers. This study recommends that stakeholders use the inquiry instruction, reshape the training, and provide the teachers with the necessary opportunities for professional development programs in an effective way.

Keywords: Inquiry-based activity, self-efficacy, outcome expectancy, teachers' belief

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Introduction

Teachers' beliefs play a significant role in shaping the instructional behaviour of teachers to influence the learning process and achievement of students (Turner & Mayer, 2009). To develop science process skills and attitudes, students require long-term, comprehensive efforts. For this, the National Research Council (NRC, 2011) promotes science inquiry implementation in science classrooms as it allows teachers to encourage and facilitate students to peruse their own

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scientific problems and develop solutions on their own. Engaging students in scientific inquiry helps them develop an understanding of scientific concepts and the nature of science (NRC, 2000). The National Research Council (2011) explains it further as the ability to ask questions, plan and conduct investigations, use appropriate tools and techniques to gather data, think critically and logically about relationships between evidence and explanations, construct and analyse alternative explanations, and share their findings by communicating with the class in a scientific argument. Therefore, the National Science Teachers Association (2004) recommends that teachers of science embrace the use of inquiry and make it the centrepiece of the science classroom. As mentioned earlier, classroom behaviour is shaped by the beliefs of teachers. As a result, it is important to explore teachers' beliefs about inquiry-based teaching (IBT), especially in class VI, as secondary education in Bangladesh is one of the most important sectors of education for achieving scientific literacy.

Purpose and research questions of the study

The purpose of the study is to investigate teachers' beliefs about IBT and learning activities. The study also seeks to understand if there is any significant difference in the beliefs of urban-rural and male-female teachers in class VI. The study is guided by the following research questions:

1. What beliefs do science teachers in class VI hold about IBT and learning activities in urban areas?
2. What beliefs do science teachers in class VI hold about IBT and learning activities in rural areas?
3. What is the difference between urban and rural teachers' beliefs towards IBT and learning activities?

Null hypothesis: There is no significant difference between the beliefs of urban and rural science teachers who participated in the study.

4. What is the difference between male and female teachers' beliefs towards IBT and learning activities?

Null hypothesis: There is no significant difference between the beliefs of male and female science teachers who participated in the study.

Teachers' belief

Teachers' beliefs are simply personal views and convictions that are purely subjective and restricted to one's opinion (Colburn, 2000). Binns and Popp (2013) mentioned that it is not educational background alone that determines whether a teacher will use an inquiry-based pedagogy; it also depends on their beliefs, values, and views and the process of acquisition

of these beliefs, values, and views. Narrowing down more, Keys and Bryan (2001) furthered that almost every aspect of science teaching is influenced by teachers' attitudes and beliefs, including how they acquire and interpret knowledge, select instructional tasks for students, interpret science content, and design assessments. Moreover, Haney, Czerniak, and Lumpe (1996) posited that the intention to implement any strategy would be the direct result of teachers' salient belief in the strategy. These attest that science teachers have individual beliefs about their teaching practice, which influence their activity in the class.

Inquiry based teaching learning activity

Scientific inquiry is the means scientists use to study nature and formulate explanations. IBT and learning activities are an active process where students are engaged to pursue knowledge in science (Anderson, 2002). The National Research Council of the U.S. (1996) linked the concept of inquiry to kind of pedagogy that combines scientific knowledge with reasoning and thinking skills. It is also a socio-constructivist approach involving collaborative work within students' resources among inquiry peers with the support of teacher groups (Vygotsky, 1978).

Teaching science according to IBT-learning

The role of the teacher in inquiry learning is basically that of a facilitator, where the teacher utilizes high-motivating strategies to engage students according to their interests and provides opportunities for further exploration (Audet, 2005). Thereby, the five features of IBT in science advocated by the National Research Council (1996) represent an understandable and more feasible structure of IBT and learning.

- creating scientific questions
- collection of evidence and observations
- explanation of observations in connection to the questions
- evaluation of the explanations
- justification through communications of the explanations

Theoretical framework of the study

As the purpose of the study is to explore science teachers' belief about inquiry at grade VI in Bangladesh, therefore, the framework of Marshall et al. (2007) has been used for this study. Marshall et al. (2007) identified several contributing factors related to inquiry instruction, e.g., supporting inquiry-based teaching and self-efficacy for this instruction and subject matter knowledge. Among these teachers' belief towards inquiry was further discussed under four sub domains. These are:

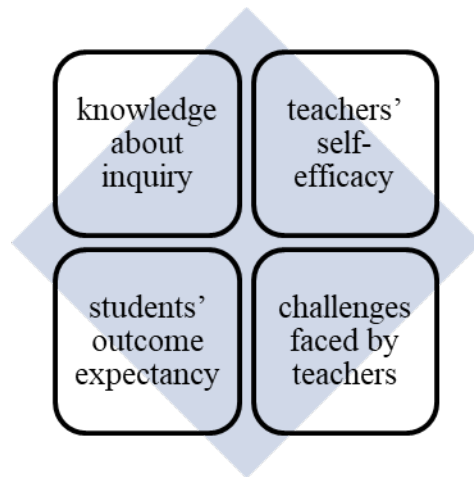


Figure 1: Four sub domains belief according to Marshall et al. (2007).

Sub domain 1: Knowledge about inquiry

According to Alake-Tuenter, Biemans, Tobi, and Mulder (2013), knowledge about inquiry mostly includes subject matter knowledge and, next to it, pedagogical content knowledge to successfully carry out inquiry-based instruction. This domain is essential to implementing curricular and instructional approaches (Borko & Putnam, 1994; Brickhouse, 1990; Brickhouse & Bodner, 1992; Pajares, 1992). According to Boujaude (2012), there is a relationship between teachers' knowledge and beliefs about inquiry and their classroom practices. The limited understanding of the inquiry process may result from teachers' lack of confidence in teaching inquiry science (Lee *et al.*, 2004; Yoon *et al.*, 2012).

Subdomain 2: Teachers' self-efficacy

Bandura (1997) defined self-efficacy as the degree to which individuals believe they can achieve at a given level in order to have an impact on events that affect their lives. It is identified as a critical impacting factor of teachers' behaviours and practices (Bandura, 1997). High self-efficacy promotes ambitious intrinsic goals and encourages analytical thinking, whereas low self-efficacy beliefs can lead to diminished task performance. A study shows that teachers who had higher self-efficacy scores devoted more time to inquiry teaching methodologies (Haddock, 2014).

Subdomain 3: Students' outcome expectancy

Student outcome expectancy is also important to reveal teachers' beliefs. Enochs and Riggs (1990) proposed that science teaching outcome expectancy is prediction to behaviour change.

They distinguished higher outcome and persistent learning is obvious in case of those teachers who believed that IBT can influence student learning and provides a greater academic focus in the classroom and provide different types of feedback than those with lower confidence to apply IBT. Teachers with high outcome expectancy assume responsibility of teaching as for student learning instead of shifting the responsibility onto the student (Berman & McLaughlin, 1977; Gibson & Dembo, 1984; Riggs & Enochs, 1990).

Sub domain 4: Challenges while applying inquiry in the class

According to Hasan (2017), several factors can be challenging, and not limiting it to teachers' teaching-related factors such as professional qualification, instructional materials, and some social and psychological factors can also play a catalyst and challenge what can influence their beliefs about applying inquiry in the class. Saad and BouJaoude (2012) found that one of the major barriers to implementing inquiry practices in science classrooms is teachers' beliefs about teaching, learning, and classroom management.

Research design and methodology

The purpose of the study is to investigate teachers' beliefs about IBT and learning activities in the knowledge and understanding, teachers' self-efficacy about inquiry, teachers' learning outcomes while applying inquiry in the class and challenges faced by teachers.

The focus of RQ 1 is to explore the beliefs of science teachers, and RQ 2 is to seek the beliefs about inquiry in rural areas. RQ 3 investigates whether there is any difference between the beliefs from an urban and rural area perspective, and RQ 4 explores the difference from a gender perspective. To answer RQ 1 and RQ 2, the sequential mixed research method was used as the quantitative data and results provided a general picture of the research problem, and further qualitative data were used to explain the general picture (Creswell, 2012). For RQ 3 and RQ 4, the quantitative method has been approached to investigate if there is any difference between their beliefs from a gender and regional perspective. A quantitative approach was performed because the last two research questions seek to establish the tendency of responses from individuals and whether they vary from area and gender perspective or not (Creswell, 2012). The quantitative and qualitative data were merged and compared for similarities and differences (Creswell, 2012). Therefore, a mixed-methods approach was used for this study as it combines both qualitative and quantitative methodologies (Tashakkori & Teddlie, 2010). Data was collected from June 2028 to December 2018.

Sample

The target population was grade VI science teachers. Using the purposive sampling method, 40 teachers were selected from urban school and rest of the 40 teachers were from rural area.

These teachers were selected through simple random sampling. In the urban area 26 teachers were male and 14 teachers were female and in the rural area 29 male teachers participated along with 11 female teachers. So, the total number of male teachers was 55 and the number of female teacher was 25 out of total 80 participants.

Research instrument

A sequential (quantitative to qualitative) mixed data analysis typology was used for data analysis. At first, a 5-point likert scale (marked with Strongly Agree, Agree, Uncertain, Disagree, and Strongly Disagree) survey instrument was applied to dairy-based teaching and learning activities. The instrument for survey data collection was adopted from David Florius Samuel (2013), Duran, E., Ballone-Duran, L., Haney, J., & Belyukova, S. (2009), and Goodrum, D. (2012). The Cronbach's alpha was measured to indicate how closely the items are related in the group. The value of the alpha coefficient is 0.717, suggesting that the items have relatively high internal consistency. Therefore, the data is reliable. Then a statistical test was used to analyze the data obtained from a survey using IBM SPSS 2.0. Percentage and mean were calculated to understand the belief level, and standard deviation was also calculated to know whether an individual varies from the total mean value and, if so, how much it is.

The analysis of the second strand, which is qualitative, depends on the initial strand. Belief score was also required benchmarks for interpretation. In this case, the five-point scale (uncertain, very low, low and moderately low) of Palmar (2006) was employed. After identifying teacher with high and low belief about IBT, teachers were further interviewed for their in-depth understanding of their beliefs about inquiry. Four participants were selected from the survey results coded as Teacher A, B, C and D. Among them teacher A and B are from urban area and teacher C and D are from rural area. It is here to mention that, teacher A and C had a positive value while teacher B and D did not show much positivity in their responses.

To know if there is any significant difference between urban-rural teachers and male-female teachers, an independent sample t-test was calculated between the results of subdomains regarding area and gender.

The figure shows the procedure of collecting data about how this study was conducted through two phases at a glance.

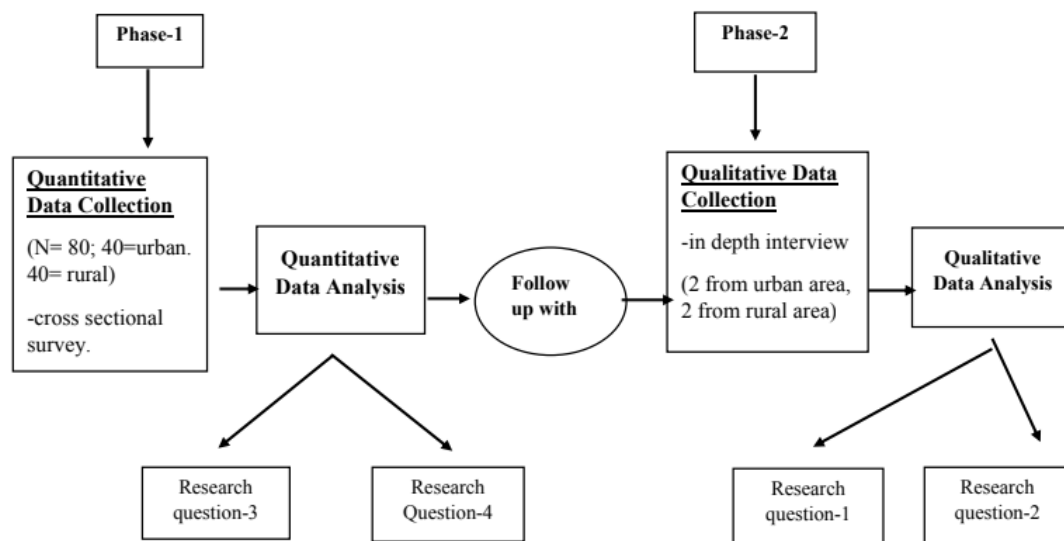


Figure 2: Data collection procedure

Findings

RQ 1: What beliefs do science teachers in class VI hold about IBT and learning activities in urban areas?

The following table shows the mean and standard deviation against the subdomains of urban teachers.

Table 2: Urban teachers' mean and standard deviation.

Subdomain	Mean	Standard deviation
Knowledge	3.20	0.87
Self-efficacy	3.15	0.95
Outcome expectancy	4.15	0.98
Challenge	3.23	1.02

From the table, we get to know that the meaning indicates that most of the teachers have “high” or “very high” as they cross 3. A low standard deviation indicates that they differ very little.

In addition to the quantitative section, data was also collected qualitatively through interviews. Two teachers were purposefully selected for the interview from the survey data who have a positive belief about IBT and learning activities (teacher A), and another one was selected from those participants who have a negative belief about inquiry (teacher B).

Teacher A tries to make science class interesting and enthusiastic by starting her class with a daily life situation to connect it with the content and lesson.

The teachers also believed that scientific abstract concepts could be understandable to learners if they were investigated practically. This was expressed correctly by a teacher during the interview:

I can see the advantage of an inquiry when I apply for it in class. There are many things that a learner finds difficult to understand, but if you give them the opportunity to work practically in a group, then it becomes easy for them to understand.

On the other hand, not having enough understanding of IBT and learning activities, Teacher B was not much interested in implementing IBT and learning. Teacher B shared experiences with traditional methods of teaching from his childhood and got the seed of his belief from there. Teacher B mentioned:

My teachers mostly focused on the content rather than building scientific value among us. We had to memorize scientific theories without even understanding them.

Summary of urban teachers' belief is presented at table.

Table 1: Urban teachers' belief

Urban teachers' belief	
Knowledge	<ul style="list-style-type: none"> • Moderate but not adequate level knowledge about inquiry. • It influences teachers' belief.
Self-efficacy	<ul style="list-style-type: none"> • Urban teachers' self-efficacy level was found high. • But do not apply inquiry based teaching learning strategy. • Interview also supported the fact.
Outcome expectancy	<ul style="list-style-type: none"> • Urban teachers' outcome expectancy level was found very high. • Most of the teachers were skilled at inquiry-based activity
Challenges	<ul style="list-style-type: none"> • Around half of the participants said they face challenges while applying inquiry. • Main challenge was related to time management and class management while applying inquiry

Overall urban teachers' belief is positive because they have very high outcome expectancy level and face less challenge but self-efficacy and majority face challenges regarding time and class management.

RQ 2: What beliefs do science teachers in class VI hold about IBT and learning activities in rural areas?

Following table shows the mean and standard deviation against the subdomains of urban teachers.

Table 2: Rural teachers' mean and standard deviation.

Subdomain	Scale mean	Standard deviation
Knowledge	3.52	1.01
Self-efficacy	2.86	0.92
Outcome expectancy	4.15	0.98
Challenges	2.94	0.95

The above table shows that most of the teachers have moderate and high standard of mean. They have a very high scale of outcome expectancy. A small standard deviation indicates that the data were closely connected and spread a little. In addition to the quantitative section, data was also collected qualitatively through interviews. Teacher C believes that making science interesting for all is necessary. To support her belief, she mentioned that:

Understanding science is important than learning science and when students find difficulties in understanding more, they lose interest in learning.

The teacher is totally conscious about her belief that through inquiry students can develop their scientific literacy. She also thinks that more training should be arranged so they can know more about inquiry.

On the contrary, Teacher D thinks implementing inquiry is difficult especially in rural areas. Because there were laboratory and equipment lacking. He thinks it requires many resources and teaching materials to use inquiry strategy. This concern was also evident in his interview:

Poor infrastructure, poor laboratory facilities and class overload make it complicated to conduct inquiry based teaching.

He also said that sometimes he didn't have time to make materials by his own and textbook was more content oriented than task. To support this, he said:

Our textbooks are mainly content and exercise oriented. Here a learner do not have much to do on his own.

Teacher D also felt that he was accountable to cover the curriculum and had a fear that his students might perform poorly if he was unable to accomplish the curriculum. Teacher D has not that much negative belief what appeared in his survey result. Moreover, he had a favorable view but due to some limitations he emerged as a negative view.

Table 3: Rural teachers' belief

Summary of rural teachers' belief	
Knowledge	<ul style="list-style-type: none"> Rural teachers' knowledge level is moderately high, but it is not adequate. It is found that majority think that inquiry needs much more teaching preparation and teaching materials. Aware of the role of science teachers in a class while applying inquiry. Half of the participants don't think that IBT suits all learning styles of the students.
Self-efficacy	<ul style="list-style-type: none"> Rural teachers' self-efficacy level is moderately low. Less than half of the teachers are able to find suitable materials and equipment to teach science using inquiry.
Outcome expectancy	<ul style="list-style-type: none"> Most of the rural teachers have a very high outcome expectancy. Most of the participant responses above or around
Challenge	<ul style="list-style-type: none"> Less than half of the rural teachers face challenges while applying inquiry. More than half of them claimed they do not receive enough support from the school administration to effectively use inquiry in teaching science. Rural teachers do not feel challenges regarding classroom space but time and classroom management.

Overall rural teachers' belief is positive because they have a very high outcome expectancy level and face less challenge. But participants' have moderately low self-efficacy and majority face challenge regarding time, class management and lack of authority support.

RQ 3: What is the difference between urban and rural teachers' beliefs towards IBT and learning activities?

The following figure shows grade 6 science teachers' knowledge, self-efficacy, outcome expectancy and challenge level of urban versus rural teachers at a glance.

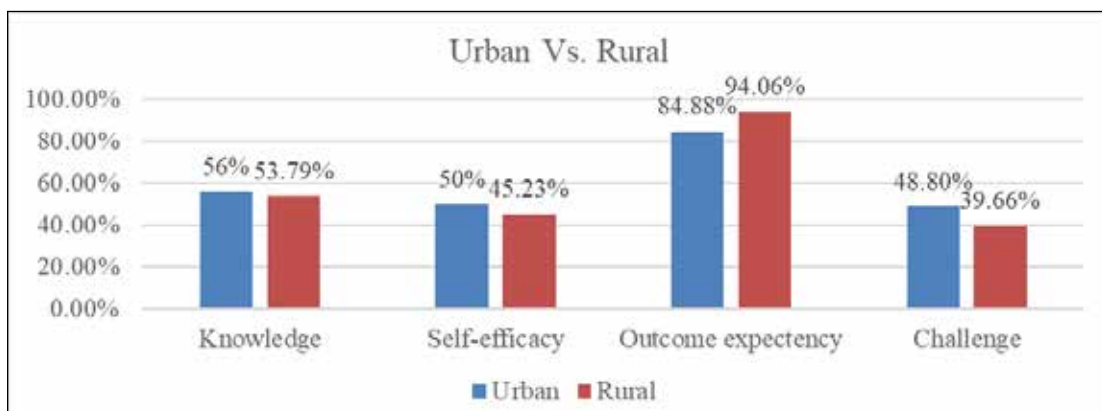


Figure 3: Grade 6 science teachers' knowledge, self-efficacy, outcome expectancy and challenge level of urban versus rural teachers

Above figure (Figure 3) shows that there is not that much significant difference between urban and rural teachers' belief. The self-efficacy level of urban teachers is quite high than the rural teachers where the figure (Figures 3) shows that the rural teachers have higher outcome expectancy than the urban teachers. The figure also shows that the urban teachers face more challenges than rural teachers while applying inquiry in the class.

To investigate, if there is any difference between the belief of urban and rural teachers regarding inquiry, mean calculation was performed. After calculating mean and standard deviation, an independent sample t-test was done to find out if there is any significant difference or not. Thus, every subdomain was calculated from an area perspective.

Table: 4: Independent Sample T Test of teachers' knowledge, self-efficacy, outcome expectancy and challenge of the urban vs. rural teachers

Subdomain	P-Value of Urban teachers Rural teachers
Knowledge about IBT learning activity	0.284
Self-efficacy	0.296
Outcome expectancy	0.394
Challenge	0.298

The above table shows that the p value is greater than 0.05. Therefore, null hypothesis cannot be rejected. There is no significant difference between the knowledge of urban and rural science teachers about IBT learning activity at grade VI.

But in the statement, "There is enough time to teach the science curriculum using inquiry-based strategies," the P-value is 0.03 which is less than 0.05 so there is a difference between urban and rural regarding this item. Moreover, P value is also greater in the statement number 32 which states that, "I have enough space in my classroom to teach science using inquiry (P-value=0.04)".

Table 5: Difference between urban and rural teacher's belief

Item	P-value
There is enough time to teach the science curriculum using inquiry-based strategies.	0.003
I have enough space in my classroom to teach science using inquiry	0.004

Therefore, there are significant differences between urban and rural teachers regards these two statements. But overall there is no significant difference between urban and rural science teachers.

RQ 4: What is the difference between male and female teachers' beliefs towards IBT and learning activities?

The following figure (figure-4) shows the science teachers' belief towards Inquiry based teaching-learning activity: Gender perspective.

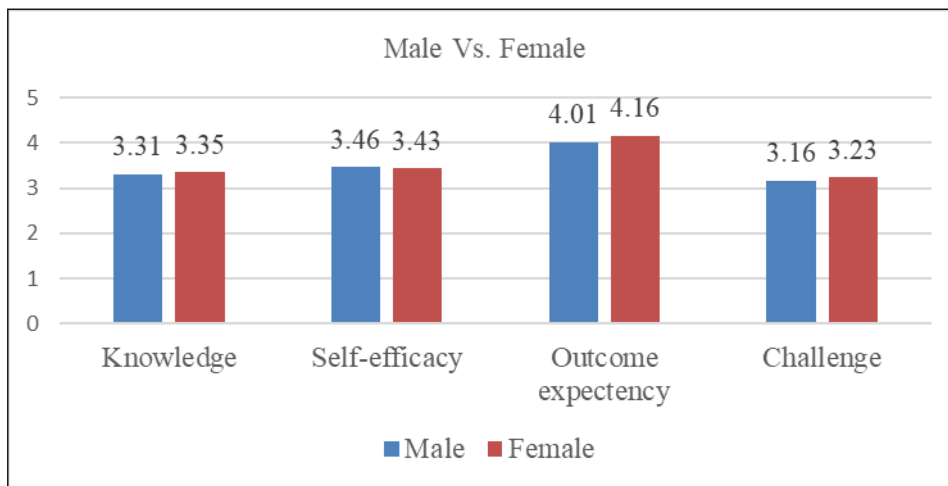


Figure 4: No significant difference between male and female teachers' belief towards IBT learning activity.

The above figure shows that both male and female teachers' have very high outcome expectancy while the figure also shows that they are high self-efficacy (Male = 3.46, Female = 3.43). Moreover, the mean scale of their knowledge level is also high. (Male = 3.31, Female = 3.35)

Table 5: Independent sample T test of knowledge, self-efficacy, outcome expectancy and challenges of male and female teachers

Subdomain	P-Value of Male teachers and Female teachers
Knowledge about IBT learning activity	0.567
Self-efficacy	0.549
Outcome expectancy	0.538
Challenge	0.549

The above table shows that the p value is greater than 0.05. Therefore, null hypothesis cannot be rejected. There is no significant difference between the challenges of male and female science teachers about IBT learning activity at grade VI.

Discussion and conclusion

The study has found that teachers from both urban and rural areas have a positive belief in IBT and learning activities in science class at grade VI. They have a moderate level of knowledge and self-efficacy about inquiry because around half of the participants' belief level is above 3 on the scale. A study by Carlsen and Monk (1992) showed that urban teachers resembled their rural colleagues more. This also reflects the present study, as rural teachers have a moderately low level of self-efficacy, but urban teachers' have a slightly higher level. A study by Nespor (1987) on teachers' beliefs revealed that a teacher might be stimulated by his or her childhood experiences as a student. This has been echoed in this study as well (Teacher B and Teacher D). Teachers with low expectancy may use the textbook as the main source alongside the curriculum (Allinder; Gibson & Dembo 1984), like Teachers B and D of this study.

As the research problem addressed, most of the teachers do not emphasize involving the students in the inquiry-based learning process. Therefore, the research question addressed the challenges. It particularly focused on the instructional and technical barriers. The identified barriers were limited time and classroom management. Moreover, the result revealed that rural teachers did not get adequate support from the school administration, which is parallel to the study of Hamedah (2017). She found the teachers felt that school environment and classroom space could be factors influencing their ability to enact structured inquiry. The present study has revealed that the challenges faced by urban and rural teachers vary regarding classroom management. Literature already cited (Anderson, 2007; Binns & Popp, 2013; Crawford, 2014; Harwood *et al.*, 2006) supports the fact that teachers' beliefs about teaching-learning activities and classroom management can be one of the major barriers.

In most cases, there was no significant difference between urban teachers and rural teachers, but a significant difference was found in the beliefs of urban teachers regarding the time of the class and the space of the classroom stated above. An alpha value of 0.05 was used to test the significance. Teacher beliefs are always influential, but they are malleable and adaptable. However, this favourable belief is not necessarily translated into their practice. The findings of the research showed that there are some strong constraints to applying inquiry in the class. Of them, the prescriptiveness of the curriculum, content-based examinations, inflexibility of the timetable, unavailability of resources, and large class size are remarkable. In Bangladesh, these factors are commonly pronounced, and therefore, although teachers respond positively to inquiry, they avoid an inquiry-based approach.

If more professional development opportunities can be given to the teachers, albeit with a focus on their attitudes and beliefs, then perhaps their beliefs about the importance and usefulness of inquiry will increase.

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