

## **Application of Technology in Teaching Mathematics: A Concept Paper for Measuring Determinants of Acceptance among School Teachers**

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### **Abstract**

In the context of Bangladesh, there is no substantial research going beyond level of belief of mathematics teachers of technology use in teaching learning process. While belief influences to motivation, perception, intention, awareness and acceptance therefore, is has been assumed in this study that there must be some determinants of acceptance among school teachers in Bangladesh. Calculators and other technological tools, such as computer algebra systems, interactive geometry software, applets, spreadsheets, and interactive presentation devices, are vital components of a high-quality mathematics education. With guidance from effective mathematics teachers, students at different levels can use these tools to support and extend mathematical reasoning and sense making, gain access to mathematical content and problem-solving contexts, and enhance computational fluency. In a well-articulated mathematics program, students can use these tools for computation, construction, and representation as they explore problems. The use of technology also contributes to mathematical reflection, problem identification, and decision making. Unfortunately, in Bangladesh bringing technology

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in mathematics teaching is less studied and overlooked. This has led this particular research to conduct this study.

## **Introduction**

Technology is an essential tool for learning mathematics in the 21st century, and all schools must ensure that all their students have access to technology. Effective teachers maximize the potential of technology to develop students' understanding, stimulate their interest, and increase their proficiency in mathematics. When technology is used strategically, it can provide access to mathematics for all students.<sup>3</sup>

Calculators and other technological tools, such as computer algebra systems, interactive geometry software, applets, spreadsheets, and interactive presentation devices, are vital components of a high-quality mathematics education. With guidance from effective mathematics teachers, students at different levels can use these tools to support and extend mathematical reasoning and sense making, gain access to mathematical content and problem-solving contexts, and enhance computational fluency. In a well-articulated mathematics program, students can use these tools for computation, construction, and representation as they explore problems. The use of technology also contributes to mathematical reflection, problem identification, and decision making.<sup>4</sup>

## **Background of the Study**

In Bangladesh the Number of primary education institutions was in 2005 more than 80,000 while the number of secondary education institutions was at that time 18,500 (see appendix-1). The number in fact grew during last ten years. However, in less than last ten years Ministry of Education took several initiatives and projects to develop some selected secondary schools (Govt. & Non Govt.) to execute the following aims:

1. To expand physical facilities of Secondary Schools (Govt. & Non-Govt.) in Bangladesh.
2. To develop village level Secondary Schools on priority basis for reducing the pressure of students in the traditional Secondary Schools (Govt. & Non- Govt.)
3. To create educational opportunities at Secondary level for ensuring geographical educational equity in Secondary Education.

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<sup>3</sup><http://www.nctm.org/about/content.aspx?id=14233>

<sup>4</sup><http://www.nctm.org/about/content.aspx?id=14233>

#### 4. To enhance the quality of education at Secondary level.

Though these aims are important for the time being but they will contribute mostly to structural change and surface level development. Pedagogy, teachers' professionalism, school principals' leadership and role need a parallel focus. Most importantly the mathematics teachers' engagement and acceptance in teaching mathematics should be focused to improve the students' achievement and outcome.

#### **Statement of the Problem**

Though the current state of Mathematics teachers is mentioned in the education statistics bureau but a personal observation reveals that teachers' performance in mathematics teaching is below satisfactory level. Therefore, undoubtedly the students' achievement is affected by the current condition. Azim & Ahmed (2007) explored teachers' beliefs about mathematics education by identifying the beliefs they hold regarding the nature of mathematics, mathematics teaching and learning of mathematics. To get a clear idea, both quantitative and qualitative data were collected from 3 districts of Bangladesh. The study revealed that teachers are holding multiple and conflicting beliefs. Analysis of quantitative and qualitative data exhibited that teachers simultaneously confirm their association with instrumentalist, Platonist and constructivist view about the nature of mathematics. Teachers show congruence towards both traditional and contemporary (constructivist) beliefs of mathematics teaching. Similarly, teachers are holding multiple beliefs about learning of mathematics. They believe students learn better on their own and at the same time believe that the role of teachers is obligatory for learning to occur among students. The overall findings of the study strongly suggest that the teachers are in between a change in their belief system that results in holding multiple beliefs about nature and teaching-learning of mathematics.

In the context of Bangladesh, there is no substantial research going beyond level of belief of mathematics teachers of technology use in teaching learning process. While belief influences to motivation, perception, intention, awareness and acceptance therefore, it has been assumed in this study that there must be some determinants of acceptance among school teachers in Bangladesh.

On top of that, mathematics teaching in Bangladesh has almost not been mentioned in the report of the TIMSS (Trends in International Mathematics and Science Study) published in several years by International Association for the Evaluation of Educational

Achievement. TIMSS assesses trends in the performance of students in the fields of mathematics and science in primary and secondary level. They aim to inform the effectiveness of curricula and instructional methods which are being provided in teaching and learning in mathematics and science subjects (Mullis et al., 2011).

Meanwhile in Bangladesh, National curriculum and Textbook Board (NCTB) is now emphasizing more on Mathematics and sciences to face the challenge of globalization. More so, some Non-Government Organization including Japan International Cooperation Agency (JICA) has recently also agreed on putting emphasize on classroom teaching, curriculum improvement, integrating more international context in the curriculum. Unfortunately, in Bangladesh bringing technology in mathematics teaching is less studied and overlooked. This has led this particular research to conduct this study.

### **Conceptual Framework**

According to Mullis et al., (2011) educational contexts, including home environment support, students' backgrounds and attitudes toward mathematics, the mathematics curriculum, teachers' education and training, classroom characteristics and activities, and school contexts for mathematics learning and instruction all are the factors that influence learners' mathematics achievement.

The Technology Acceptance Model (TAM) is an information systems theory that models how users come to accept and use a technology. The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it, notably:

Perceived usefulness (PU) - This was defined as 'the degree to which a person believes that using a particular system would enhance his or her job performance'.

Perceived ease-of-use (PEOU) was defined this as 'the degree to which a person believes that using a particular system would be free from effort' (Davis 1989).

Based on the theory of reasoned Action, Davis (1986) developed the Technology Acceptance Model which deals more specifically with the prediction of the acceptability of an information system. The purpose of this model is to predict the acceptability of a tool and to identify the modifications which must be brought to the system in order to make it acceptable to users. This model suggests that the acceptability of an information system

is determined by two main factors: perceived usefulness and perceived ease of use.

Perceived usefulness is defined as being the degree to which a person believes that the use of a system will improve his performance. Perceived ease of use refers to the degree to which a person believes that the use of a system will be effortless. Several factorial analyses demonstrated that perceived usefulness and perceived ease of use can be considered as two different dimensions (Hauser et Shugan, 1980 ; Larcker et Lessig, 1980 ; Swanson, 1987).

As demonstrated in the theory of reasoned Action, the Technology Acceptance Model postulates that the use of an information system is determined by the behavioral intention, but on the other hand, that the behavioral intention is determined by the person's attitude towards the use of the system and also by his perception of its utility. According to Davis, the attitude of an individual is not the only factor that determines his use of a system, but is also based on the impact which it may have on his performance. Therefore, even if an employee does not welcome an information system, the probability that he will use it is high if he perceives that the system will improve his performance at work. Besides, the Technology Acceptance Model hypothesizes a direct link between perceived usefulness and perceived ease of use. With two systems offering the same features, a user will find more useful the one that he finds easier to use (Dillon and Morris, on 1996).

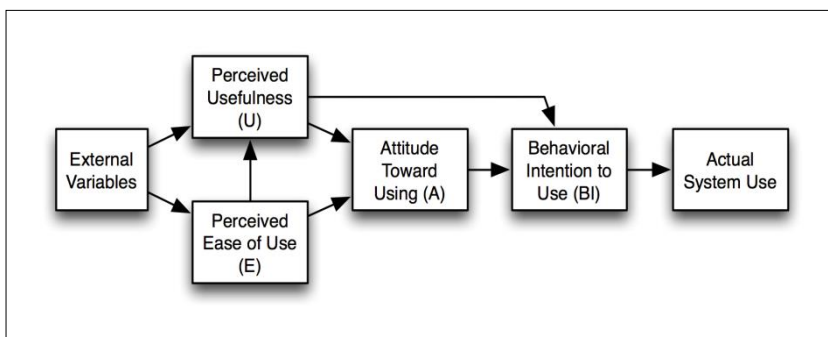


Figure 1: Technology Acceptance Model among Mathematics Teachers

## Research Objectives

1. To determine the influence of external variables (user training, Socio-economic background, age) on teachers' beliefs about using the technological teaching aid;

2. To examine the influence of teachers' beliefs on their attitudes about using the technological teaching aid;
3. To measure impact of teachers' attitudes on their intentions to use the technological teaching aid;
4. To determine the impact of teachers intentions on level of usage of the technological teaching aid

### **Research Questions**

1. To what extent the external variables (user training, Socio-economic background, age) influence teachers' beliefs about using the technological teaching aid?
2. Does teachers' beliefs have any impact on their attitudes about using the technological teaching aid;
3. How does teachers' attitudes related to their intentions to use the technological teaching aid;
4. To what extent teachers intentions influence on level of usage of the technological teaching aid

### **Research Hypothesis**

*H1:* External variables (user training, Socio-economic background, age) influences user beliefs about using the system;

*H2:* User beliefs influence their attitudes about using a system;

*H3:* User attitudes influence their intentions to use a system;

*H4:* User intentions determine level of usage of the system.

### **Methodology**

The purpose of 'methodology' chapter is to illustrate the methods that are used in this study to answer the research questions and hypotheses outlined in chapter one and two. This is the critical section of this study where the author explains the procedures, methods and techniques that is used for the collection of primary data. So this chapter is the platform from which it is possible to judge the overall soundness of the conclusions drawn at the end of the study. Therefore, this chapter includes methodological steps used in order to complete this study. The major steps of quantitative research approach for example the research design, sample and population of the study, sampling procedures, instrumentization i.e. validation, description of the variables, research sites were discussed.

### **Research Design**

This study is describing the state of affairs as it exists at present in other words it is an *Ex post facto* research (Kothari, 2010). The main characteristic of this design is that the researcher can only report what has happened or what is happening that means it is ex-post

facto because the effect and the alleged cause that the researcher studied had happened before s/he came to the scene (Moshood, 2014). This descriptive research includes surveys and fact-finding enquiries by presupposing some hypotheses (Kothari, 2010). Testing hypothesis is deductive in nature and thus this current study is quantitative in nature (Ary, Jacobs, Razavieh, & Sorensen, 2010). In quantitative research the researcher attempts to simplify and explain phenomenon and reality through carefully designed and controlled data collection and analysis (Fraenkel, Wallen, & Hyun, 2012). So, this study will be performed by employing quantitative research techniques and all of the variables are well constructed and defined (Ary et al., 2010).

### **Sample Size**

Most of the time, it is almost impossible for the whole population to be used in a study, especially where the population is too large. This situation usually necessitates the drawing of legitimate sample size from the population. To arrive at the needed sample size, a procedure or method known as sampling procedure is usually followed. Sample is a subset or subgroup of the target population that the researchers intend to study for generalizing any decision within the target population (Springer, 2010; Vockell & Asher, 1998; Wallen & Fraenkel, 2011). However, it is also important to understand that the sample size depends on the statistical technique that will be used in the study. So as noted earlier, the statistical tools that were employed for this study is Confirmatory Factor Analysis (CFA), using Structural Equation Modeling (SEM).

For confirmatory factor analysis using SEM, as a rule of thumb, a sample higher than 200 is enough to provide sufficient statistical power for data analysis (Hoe, 2008). Even SEM models can perform well with as few as 50 to 100 samples (Iacobucci, 2010). But the idea that sample size should be >200 is conservative and is surely simplistic (Yangaiya, 2013). But Hair, Black, Babin and Anderson (2010) note that sample size selection in SEM depends on the nature of the model. For example, they suggest that a model with five and below constructs, with each construct having more than three items (observed variables) and with high item communalities like .6 and above, a minimum of 100 sample size can effectively be used. But a model with five to seven constructs with lower communalities of .45, and below and constructs with fewer than three items, a minimum sample size of 300 should be used (Hair, Black, Babin, & Anderson, 2010).

Table: Identification of Sample Size for University

| Population Size | Confidence= 95%<br>Margin of Error |      |      |      | Confidence= 99%<br>Margin of Error |      |      |       |
|-----------------|------------------------------------|------|------|------|------------------------------------|------|------|-------|
|                 | 5.0%                               | 3.5% | 2.5% | 1.0% | 5.0%                               | 3.5% | 2.5% | 1.0%  |
| 10              | 10                                 | 10   | 10   | 10   | 10                                 | 10   | 10   | 10    |
| 20              | 19                                 | 20   | 20   | 20   | 19                                 | 20   | 20   | 20    |
| 30              | 28                                 | 29   | 29   | 30   | 29                                 | 29   | 30   | 30    |
| 50              | 44                                 | 47   | 48   | 50   | 47                                 | 48   | 49   | 50    |
| 75              | 63                                 | 69   | 72   | 74   | 67                                 | 71   | 73   | 75    |
| 100             | 80                                 | 89   | 94   | 99   | 87                                 | 93   | 96   | 99    |
| 150             | 108                                | 126  | 137  | 148  | 122                                | 135  | 142  | 149   |
| 200             | 132                                | 160  | 177  | 196  | 154                                | 174  | 186  | 198   |
| 250             | 152                                | 190  | 215  | 244  | 182                                | 211  | 229  | 245   |
| 300             | 169                                | 217  | 251  | 291  | 207                                | 246  | 270  | 295   |
| 400             | 196                                | 265  | 318  | 384  | 250                                | 309  | 348  | 391   |
| 500             | 217                                | 306  | 377  | 475  | 285                                | 365  | 421  | 485   |
| 600             | 234                                | 340  | 432  | 565  | 315                                | 416  | 490  | 579   |
| 700             | 248                                | 370  | 481  | 653  | 341                                | 462  | 554  | 672   |
| 800             | 260                                | 396  | 526  | 739  | 363                                | 503  | 615  | 763   |
| 1000            | 278                                | 440  | 606  | 906  | 399                                | 575  | 727  | 943   |
| 1200            | 291                                | 474  | 674  | 1067 | 427                                | 636  | 827  | 1119  |
| 1500            | 306                                | 515  | 759  | 1297 | 460                                | 712  | 959  | 1376  |
| 2000            | 322                                | 563  | 869  | 1655 | 493                                | 808  | 1141 | 1785  |
| 2500            | 333                                | 597  | 952  | 1984 | 522                                | 879  | 1288 | 2173  |
| 3500            | 346                                | 641  | 1068 | 2565 | 558                                | 977  | 1510 | 2890  |
| 5000            | 357                                | 678  | 1176 | 3288 | 586                                | 1066 | 1734 | 3842  |
| 7500            | 365                                | 710  | 1275 | 4211 | 610                                | 1147 | 1960 | 5165  |
| 10000           | 370                                | 727  | 1332 | 4899 | 622                                | 1193 | 2098 | 6239  |
| 25000           | 378                                | 760  | 1448 | 6939 | 646                                | 1285 | 2399 | 9972  |
| 50000           | 381                                | 772  | 1491 | 8056 | 655                                | 1318 | 2520 | 12455 |
| 75000           | 382                                | 776  | 1506 | 8514 | 658                                | 1330 | 2563 | 13583 |
| 100000          | 383                                | 778  | 1513 | 8762 | 659                                | 1336 | 2585 | 14227 |
| 250000          | 384                                | 782  | 1527 | 9248 | 662                                | 1347 | 2626 | 15555 |

Source: Krejcie and Morgan (1970: 608) in Yangaiya (2013)

Based on Table 3.2 researchers may choose their sample size based on the population size (Column 1) and confidence interval and margin of error (Columns 2 and 3). Consequently, this study used a 95% confidence level and a 5% margin of error to arrive at the needed sample (Vockell& Asher, 1998). Therefore, 400 academic leaders were selected for the survey. The decision to take the above sample size is because as noted by Hair et al.(2010), the sample size to be used in a study ought to be at least 100 or higher and generally the sample size should be at least five times the number of variables to be used in the study. But preferably, 10:1 ratio should be used.

### Sampling Techniques

When conducting a study, researchers are faced with the option of using one of the two sampling techniques that is probability or non-

probability sampling techniques (Creswell, 2010; Cooper, 2011). Creswell explains that in probability sampling individuals selected for the study are representatives of that population where the sample was drawn; however, in non-probability sampling individuals are selected because of their availability, convenience and they represent some characteristics the investigator seeks to study. Springer (2010) explains that probability sampling involves all techniques of sampling where respondents in the population have the same chance of being chosen, where as, non-probability sampling is a technique in which the probability of each individual or object in a population will be selected in a study is unknown.

Furthermore, probability sampling provides known non-zero chance to each member of the population, unlike in the non-probability sampling where possibility of selecting an elements of the population is unknown (Sekaran & Bougie, 2010; Cooper, 2011). Table 3.3 summarizes the sampling techniques available in both probability and non probability sampling approaches.

Table 3.3 Probability and Non-Probability Sampling Approaches

| Approach of sampling        | Simple definition                                                                   |
|-----------------------------|-------------------------------------------------------------------------------------|
| <b>Probability</b>          |                                                                                     |
| Simple random               | Each member of the population has equal chance of being selected.                   |
| Proportional stratified     | The proportion of each sub group within the sample is the same as in the population |
| Non-proportional stratified | Each sub group of the population is present in the sample but not proportionally    |
| Cluster                     | An entire, intact group is selected from the population                             |
| Systematic                  | Each Nth individual or object of the population is selected from the list           |
| <b>Non-Probability</b>      |                                                                                     |
| Convenience                 | The sample involves all those available and accessible for the study                |
| Purposive                   | The sample assumed to be representative of the population is selected               |
| Quota                       | Members of the population who have certain characteristics are chosen               |

Source: Adopted from Springer (2010: 108)

In probability sampling, the sample obtained can be said to be representative of the population. Consequently, the findings obtained can be generalized to the entire population (Creswell,

2010; Sekaran & Bougie, 2010). This study used probability sampling to get the needed sample size. The decision to use probability sampling technique was informed by the fact that probability sampling of any kind is more desirable than non-probability sampling (Springer, 2010). Moreover, under probability sampling, stratified random sampling was used. Stratified random sampling is a method of sample selection in which the population of the study is divided into groups with similar characteristics, known as strata, after which a random or systematic sampling is applied to come up with the needed sample from each stratum (Johnson & Christensen, 2000).

In explaining the stratified random sampling, Koul (1992: 112) notes that “when the units in a sample are proportional to their presence in the population, the sample is said to be stratified.” In addition, Wiersma (1995) argues that in stratified random sampling the population is divided into two or more divisions called strata.

Stratified random sampling is divided into two, namely; equal allocation and proportional allocation. Unequal allocation each sub-group is given equal number of the sample, whereas, in proportional allocation each sub-group contribution to the sample depends on its size in the population. However, this study used the later option. The decision to choose proportional stratified random sample is because as explained by Johnson and Christensen (2000) when a proportional stratified random sample is obtained, the proportions in the sample on the stratification variable will be equal or almost equal representation of the population on that same stratification variable in the population. The formula for calculating proportional stratified random

Sample is;  $\frac{SP}{TP} \times IS$  where:

SP = Stratum population

TP = Total population and

IS = Identified sample

### **Instrument**

#### **Perceived Usefulness (PU)**

PU1: Using technology enables me to accomplish tasks more quickly.

PU2: Using technology improves my performance.

PU3: Using technology increases my productivity.

PU4: Using technology enhances my effectiveness.

#### **Perceived Ease of Use (PEU)**

PEU1: Learning to use technology is easy for me.

PEU2: I find it easy to use technology to do what I want to do.

PEU3: My interaction with technology does not require much effort.

PEU4: It is easy for me to become skilful at using technology.

PEU5: I find technology easy to use.

#### **Subjective Norm (SN)**

SN1: People who influence my behavior think that I should use technology.

SN2: People who are important to me think that I should use technology.

#### **Facilitating Conditions (FC)**

FC1: When I encounter difficulties in using technology, a specific person is available to provide assistance.

FC2: When I encounter difficulties in using technology, I know where to seek assistance.

FC3: When I encounter difficulties in using technology, I am given timely assistance.

#### **Attitude Towards Use (ATU)**

ATU1: Once I start using technology, I find it hard to stop.

ATU2: I look forward to those aspects of my job that require the use of technology.

ATU3: I like working with technology.

#### **Behavioral Intention to Use (BIU)**

BIU1: I intend to continue to use technology in the future.

BIU2: I expect that I would use technology in the future. BIU3: I plan to use technology in the future.

### **Data Analysis**

#### ***Confirmatory Factor Analysis***

As the name implies, Confirmatory Factor Analysis (CFA) is an analysis usually carried out to confirm a theory and/or hypothesis. This analysis is usually carried out using Structural Equation Modeling (SEM). Confirmatory Factor Analysis is a complex and advanced method used later in a study in order to test a hypothesis or theory (Pallant, 2007; Tabanichnick & Fidell, 2007). According to Ullman (2006) CFA is employed in a study when the hypothesized relationship between the observed variables and construct has been established. CFA addresses practical issues like the validity of the structure of a scale. Furthermore, Schreiber, Stage and King (2006) argue that CFA is a confirmatory method driven by theory. It should be noted that before deciding to use CFA, there must be a strong relationship between observed and latent variables. This position is concurred by Ullman (2006) who notes that in EFA the number of factors and their relationship are examined but in CFA, the researcher has strong ideas about the number of factors and the relationship between those factors and

observed variables. Kline (2011) indicates that CFA analyzes a prior measurement model in which the number of constructs and their relationship with the indicators are clearly specified. The decision to use CFA as one of the tools for data analysis is to enable the study to answer some of the research questions, which seek to find out the relationship between observed and latent variables. This is because as noted by Schreiber et al. (2006) the planning to use CFA as a tool in the analysis is driven by the theoretical relationship among observed and unobserved variables.

Structural Equation Modeling (SEM) is a group of statistical methods, which allows relationships between one or more independent variables (IVs) and one or more dependent variables (DVs), to be investigated (Ullman, 2007; Hair et. al., 2010). Ullman further argues that SEM is a combination of Exploratory Factor Analysis(EFA) and multiple regression analyses. Furthermore, SEM is an effective statistical technique that combines measurement model or Confirmatory Factor Analysis (CFA) and structural model into a simultaneous statistical test. It is more versatile compared to other multivariate methods as it is possible with SEM to establish simultaneous multiple dependent relationship between variables (Hoe, 2008). SEM has the flexibility to model relationships among multiple predictor and criterion variables, and statistically tests a priori theoretical assumptions against empirical data through CFA (Chin, 1998 as cited by Hoe, 2008: 76). Furthermore, Byrne (2010) defines SEM as a statistical technique that takes a confirmatory (i.e. hypothesis testing) approach to the analysis of a structural theory bearing on some phenomenon.

The selection of SEM to analyze the data collected is because as noted by Hair et al. (2010), SEM is the most effective technique when the study involves multiple constructs, each represented by many measured variables. These constructs are differentiated based on whether they are exogenous or endogenous. Additionally, Ullman (2007: 679) argues that “when the phenomenon of interest is complex and multidimensional, SEM is the only analysis that allows complete and simultaneous tests of all the relationships.” SEM was used in this study to evaluate the measurement models through CFA.

SEM was used to evaluate the model fit, based on nine fit indices. This step will lead to answering Question 12 which asked whether the model fits the data or not. It should be noted that examining whether the model of the study fits the data is one of the most important steps in SEM (Yuan, 2005 as cited by Hooper, Coughlan & Mullen, 2008). To assess the model fit, there are many

indicators of goodness-of-fit (Hoe, 2008) that need to be used. For this study nine fit indices were used. These fit indices are chi-square (CMIN), normed chi-square (CMIN/DF), root mean square error of approximation (RMSEA), Comparative fit index (CFI), P-value, degree of freedom (DF), Goodness of fit statistics (GFI), normed fit index (NFI) Tucker Lewis Index (TLI), and Standardize root mean square residual (SRMR). It is worth stressing that different thresholds were used for different fit indices when assessing the model fit. Table 3.7 provides some acceptable thresholds for determining the model fit in SEM.

### **Literature Review**

Plenty of researches have been conducted internationally on teacher belief and mathematics teachers' beliefs in particular. Researchers suggest that to investigate beliefs, it is necessary to recognize that beliefs are related in complex ways and not held in isolation from one another (Beswick, 2006). To examine and describe how an individual's beliefs are organized, researchers often consider a metaphorical idea of belief systems (Green 1971 as in Pepin, 1999). A teachers' belief system consists of beliefs about students, learning, the nature of subject epistemology, and the role of teachers (Wallace and Kang, 2004; as cited in Boz, 2008). Teachers' mathematical belief refers to those beliefs systems held by teachers on the teaching and learning of mathematics (Handal, 2003). This study was conducted keeping in mind the belief components identified by Ernest (1989) for describing mathematics teachers' beliefs. According to him these components are: view or conception of the nature of mathematics, model or view of the nature of mathematics teaching, and model or view of the process of mathematics learning.

Teachers' beliefs about nature of mathematics determine his/her approach towards mathematics. Thompson (1984) identified three distinctive philosophies that repeatedly occur in mathematics teaching. These are instrumentalist, Platonist, and constructivist views of mathematics. Instrumentalist view perceive mathematics as an accumulation of facts, rules and skills to be used in pursuance of some external ends, it is a set of unrelated but utilitarian rules and facts (Ernest, 1989). It involves less knowledge. It is easier to understand and one can often get the right answer more quickly and reliably through instrumental thinking (Skemp, 1976). Instrumentalist views of mathematics are often seen as traditionalist views (Mura, 1995). In the Platonistic conception, subject matter of mathematics consists of 'abstract entities' (Horsten, 2007) and they furnish models of 'abstract imagination' (Bernays, 1935). Mathematical objects are independent of us and our language,

thought, and practices (Stanford Encyclopedia of Philosophy, 2009).

Constructivism has two basic principles. One is that learner builds up knowledge as an active participant in the learning process and the other is, such construction of meaning is adaptive in making the best possible sense of the learner's experiential world (Glaserfeld, 1989). In constructivism, an individual is the key constructor of knowledge in opposition or parallel to one on social/cultural aspects (Steffe and Thompson, 2000; Lerman, 2000). There have been a significant impact of the constructivist theory(ies) on theoretical debate in the last decade (Ernest, 1995). According to Habib (2008), the present quest of quality of education in the schools of Bangladesh has much to do with constructivism. As the teachers and students become more constructive in the class the learning will be more effective and pro-generative in terms of further achievement.

Ernest (1989) suggests that as psychological system of belief, these three philosophies of mathematics can be conjectured to form a hierarchy. Instrumentalism, involving knowledge of mathematical facts, rules and methods as separate entities, is at the lower level. At the next level is the Platonist view of mathematics, involving a global understanding of mathematics as a consistent, connected and objective structure. At the highest level, the problem solving view sees mathematics as a dynamically organized structure located in a social and cultural context.

In view of mathematics teaching literature, two schemes can be identified for classifying beliefs on teaching mathematics. They include a traditional transmission approach where students are expected to absorb and reproduce information and rules that the teacher transmits to them and a contemporary constructivist approach in which students construct their own mathematical knowledge through interaction with the environment and teachers are the facilitators of learning (Burton, 1993; Barkatsas and Malone, 2005; Shahvarani and Savizi, 2007). Findings of other education researchers also support these two major beliefs existence among mathematics teachers (Prawat, 1992).

Literature in mathematics education shows that, most effective way of learning mathematics is perceived to be rote algorithmic and repetitive procedures by teachers. They see mathematics as a fixed and sequential body of knowledge (Foss and Kleinsasser, 1996 and Mayers, 1994 as cited in Schuck and Folley, 1999). Teachers hold limited views of what mathematics is - static and mechanistic views, rather than the view as a dynamic problem driven ever-expanding field of human creation (a view more

aligned with the constructivist model of learning) - and this impacts on their approach to teaching (Nisbet and Warren, 2000).

An extensive review of research on teacher belief about mathematics teaching-learning by Azim and Ahmed (2010) suggests that traditional beliefs about mathematics teaching perceive teachers as the transmitter of knowledge which is also known as transmission beliefs. In constructivist belief of mathematics teaching, teachers work as a guide or leader in the teaching process and facilitate construction of mathematical knowledge and ability among students instead of providing them with ready-made solutions and answers and these are known as contemporary or modern beliefs of mathematics teaching. In traditional beliefs, learning mathematics is perceived to be passive reception of knowledge, students are submissive and compliant. Contemporary or modern constructivist beliefs of learning mathematics encourages autonomy and development of child interests. Learning is an active construction. Students' own efforts to understand mathematics through activities and discussions is placed at the center of educational endeavor. Similar arguments were also put forward by Barkatsas and Malone (2005) and Shahvarani and Savizi (2007).

### Conclusion

In Bangladesh, National curriculum and Textbook Board (NCTB) is now emphasizing more on Mathematics and sciences to face the challenge of globalization. More so, some Non-Government Organization including Japan International Cooperation Agency (JICA) has recently also agreed on putting emphasize on classroom teaching, curriculum improvement, integrating more international context in the curriculum. Unfortunately, in Bangladesh bringing technology in mathematics teaching is less studied and overlooked. This has led this particular research to conduct this study.

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**Appendix-1: Number of Primary and Secondary Institutions in Bangladesh, Teachers, Enrolled Students**

| Type of institution               | Mangement       | No. of Instn. |         | No. of Teachers |         | No. of Student |         |
|-----------------------------------|-----------------|---------------|---------|-----------------|---------|----------------|---------|
|                                   |                 | Total         | Femal e | Total           | Femal e | Total          | Female  |
| Primary School                    | Public          | 37672         | n.a     | 162084          | 71740   | 9483891        | 4848049 |
|                                   | Registered      | 19682         | n.a     | 76566           | 22833   | 3572686        | 1802605 |
|                                   | Non-regd        | 946           | n.a     | 3456            | 2200    | 158059         | 78186   |
|                                   | Experimental    | 54            | -       | 223             | 84      | 9828           | 4762    |
|                                   | Private (All)   | 42725         | -       | 182705          | 53250   | 6741767        | 3286388 |
|                                   | Total (Primary) | 80397         | -       | 344789          | 124990  | 16225658       | 8134437 |
| Junior School                     | Private         | 4322          | 1247    | 36070           | 7299    | 910914         | 531164  |
| Secondary School                  | Public          | 317           | 147     | 7434            | 2333    | 221887         | 106316  |
|                                   | Private         | 13224         | 2191    | 178269          | 13652   | 5900743        | 3031619 |
| School & College (school scetion) | Private         | 638           | 124     | 11156           | 3699    | 365008         | 198915  |
| Total (Secondary Education )      | Public          | 317           | 147     | 7434            | 2333    | 221887         | 106316  |
|                                   | Private         | 18183         | 3561    | 225495          | 44650   | 7176665        | 3761698 |
|                                   | Total           | 18500         | 3708    | 232929          | 46983   | 7398552        | 3868014 |

Source: Ministry of Education: 2005 (Retrieved from: [http://www.moedu.gov.bd/old/edu\\_statistics.php](http://www.moedu.gov.bd/old/edu_statistics.php))