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Determination of mathematics teachers' opinions related to response and solution-based software in secondary education institutions

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Abstract

This paper analyses the challenges and opportunities of E-banking in Bangladesh. It also discusses the success of E-banking in small-to-midsized enterprise (SMEs) of Bangladesh and gives a reliable assessment of Bangladesh's present E-banking infrastructure and its future organisational structure. This paper mainly has used secondary research data and methods to provide a broad investigation of E-banking in Bangladesh, how to overcome the hurdles in SMEs of Bangladesh necessary for SMEs to help facilitate E-banking adoption. The research is a subject to academic journal articles, project reports, media articles, corporation-based documents and other appropriate information. Data were also collected by using interviews from Bangladesh E-banking-based organisations that are offering their goods and services on electronic channels and professionals involved with E-banking-related activities. E-banking can provide speedier, faster and reliable services to the customers for which they are relatively happy. E-banking services not only can develop new competitive advantages, it can improve its relationships with customers.

Keywords: E-banking, small-to-mid-sized enterprises (SMEs), challenges, opportunities, Bangladesh.

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1. Introduction

Developments in information and technology, individual and social demands and problems encountered in daily life increase the need for individuals who value the mathematics, have developed mathematical thinking skills and can use mathematics in modelling and problem solving (Ministry of National Education [MEB], 2017). This need, especially due to the developments in information and communication technologies, necessitates the use of computer technology in mathematics education. The use of educational technologies, especially computers, embodies mathematics, which is an abstract course, increases students' interest in mathematics and makes learning more meaningful and permanent by making mathematics enjoyable. It can be said that this situation causes researchers and educators to focus on computer-assisted teaching studies in mathematics education (Kutluca, Birgin & Günduz, 2018). One of the most common difficulties form teachers face in mathematics teaching and in literature is the concretisation of abstract subjects in teaching basic subjects (Ceker & Uzunboylu, 2016; Kukey, Gunes & Genc, 2019).

The most mentioned term about the use of computers in teaching is Computer Assisted Instruction. In BDI, computer is used as a tool for teaching a course. Students who use course software for teaching purposes, can learn the subject at their own pace and abilities on the computer. In computer assisted education, a subject in any lesson is taught with pre-prepared software (Duman, 2017; Mavi & Uzunboylu, 2014).

Computer-assisted education is a teaching method consisting of combining the principles of self-learning with computer technology, in which the computer is used as an environment where learning occurs, which strengthens the teaching process and student motivation and which the student can benefit according to his/her own learning speed. Computer-assisted education can be defined as activities in which students interact with the lessons programmed on the computer and the teacher plays the role of guide and computer plays the role of environment (Sunbul, 2000).

The benefits of computer assisted education for students and teachers can be listed as follows (Dincer, 2015):

- Unclear points can be repeated as many times as desired by the student.
- There is no dependence on someone else during learning. Each student learns at their own learning speed.
- During the implementation of computer-assisted education, the student has to actively participate in lessons.
- Errors and omissions are immediately seen and corrected during learning.
- There is tolerance towards mistakes. The student always has the chance to answer again.
- It always keeps the students' interest towards the lesson alive.
- Saves the teacher from repetition of the lessons, error, homework correction and similar jobs and gives him/her the opportunity to deal more closely with students.
- In computer assisted education, dangerous or expensive experiments or studies can be done easily by the simulation method.
- Differences between teaching methods applied by teachers during their lessons can be minimised by computer assisted education. Teachers receive computer training as the most useful way of acquiring computer skills and knowledge (Bevans, Donaldson & Al-Bataineh, 2015).
- Students can learn systematically and in a shorter time.
- While watching the lesson, students' attention levels can be kept high by means of drawings, colours, shapes and pictures.
- Since the learning is reduced to small units, the steps are tested on these units and carried out step by step.
- The usefulness of knowledge taught in mathematics classes is often possible with its comprehension and implementation.

Mathematics is a science that we sometimes see and use directly in our lives. It makes sense to our lives. For this reason, the mathematics that affects our lives is of great importance in our schools (Tezer, 2018; Tezer & Cumhur, 2017). Mathematics is a factor that makes it easier for people to understand the world, and therefore to improve their lives and generate ideas. Therefore, in all reforms implemented in modern education, the most important objective is to develop a system that will help students learn better by understanding mathematics (Cumhur & Tezer, 2019).

In addition to mathematical achievement, conceptual comprehension and application levels become very important. Therefore, the methods used in mathematics lessons vary. Sometimes, even when presenting a subject, several methods may be necessary (Akkoyunlu, 1998).

The main methods used in mathematics lessons are teaching through plain narration, definitions, invention, scenario, analysis, demonstration, rules, experimental activities and games. In addition to these, the methods related to stem cell model have started to be used (Chernyavskikh et al., 2018). Each of these methods has certain advantages and limitations. Therefore, you need to be careful in choosing the method. These types of methods are not alternatives to each other, and the situations in which each is suitable are different. Sometimes more than one method may be appropriate for the same situation. In such cases, the teacher should be able to make a choice as someone who knows the learning environment and students. What is expected from the method is to lead children to develop positive attitudes towards mathematics, to give way to student participation as much as possible and to contribute to increase success.

It is found that 'Reverse-Faced Teaching' approach in mathematics classes positively affects students' academic achievement and attitudes towards mathematics (Karadag & Keskin, 2017). With Computer-Assisted Mathematics teaching, the fact that students develop positive attitudes towards their lessons and implement them to increase their success is very old. Tall explained the use of computers in mathematics education as follows (Tall and Thomas, 1991; Uzunboylu & Cumhur, 2015):

Digital Flow Chart; The first microprocessor computers (for example, Apple, 1976) were introduced to use the BASIC programming language. By means of programming, it was thought that the process steps of mathematics will be learned better. However, the fact that computers are not in a state that every student can receive, and work has created problems. Research has shown that students learn algebra by programming in BASIC.

Graphic; the use of computers in mathematics education with graphics-based programs opened the second stage. With the help of graphic-based software, students have the opportunity to imagine mathematical ideas on topics, such as geometry, statistics, calculation and differential equations. The students developed their creativity by imagining about the subjects.

Unlimited Use; With the introduction of the mouse (1984), the use of options in mathematics software has increased. Software has been developed extending the edges of a selected triangle with the help of a mouse and displaying the change of angles instantly.

Algebra System; In 1984, it was predicted in the American Mathematical Monthly that software would be capable of factorising or multiplying, analytically or numerically solving equations, performing integral solutions, and solving functions in the Taylor or Laurent series. These developments have been observed in less than a decade. The aim of the software is based on the student's graphical, numerical and analytical thinking on appropriate topics (Hallett, 1991).

Personally Transportable Tools; Calculators with four operations were developed with scientific functions and programmability. In 1996, handheld computers were produced. The main subjects of mathematics and geometry examinations were embodied by numerical and symbolic algorithms of handheld computers.

Multimedia; Interactive software was developed in the individual study. Through these software, the student reached various materials of mathematical operations and subjects in written, audio and video formats.

WWW (The World Wide Web); Students had access to interactive mathematics software from their desks at any time.

Yavuzsoy (2001), in his research, examined the new technologies used in mathematics teaching in France in a broad framework from pre-1970 to the present day and included the historical development process of mathematics education and the use of these technologies in mathematics education. In addition, the structure of teacher training institutions and the compatibility of this structure with new technologies were examined. For example, it is very important that the geometry computer programs used allow new operations, provide the ability to instantly see the changes while preserving the properties of the geometric shapes, and direct the student to examine, explore and develop. The effects of computer programs such as Cabri-Geomètre, Geospace, Geoplan, Excel and similar, which are widely used in schools in France, have been examined. In this context, the programs that teachers and prospective teachers prefer to use in mathematics teaching and the reasons why they use these programs were emphasised, and then the effects of these programs on students are examined. The problems they face were tried to be presented. This research was carried out on four mathematics teachers in three different French cities (Lyon, Grenoble and Avignon) and 28 interns in Lyon. Qualitative research method was used in the research and content analysis was applied. The results were discussed separately from the point of the students and teachers and the educational dimension of the use of new technologies in mathematics education was included.

Tatar, Kagizmanli & Akkaya (2013) were examined 126 published articles about technology-based mathematics education in 32 peer-reviewed journals in Turkey between 2000 and 2011. As a result of the research, it was found that most of the studies (76%) had one or two authors and the keywords specific to the subject area of mathematics were used very little (11%). In these studies, where the use of mathematics software was low, researchers mostly preferred undergraduate students as a sample and a questionnaire as a data collection tool. In these studies, where qualitative and quantitative research studies were used with the same frequency, it was determined that mean, standard deviation and t-test were used in quantitative data analysis, and descriptive analysis was predominantly used in qualitative data analysis. However, Yucedag (2010) has evaluated 390 master's thesis in the field of mathematics education and a total of 153 studies in four magazines in Turkey between 2000 and 2009. Kutluca, Haciomeroglu and Gunduz (2016) have evaluated the studies based on computer-assisted teaching of mathematics in Turkey. On the other hand, Acikgul and Aslaner (2014) examined the studies related to computer-assisted teaching, of which sample is consisted of prospective mathematics teachers. Because it has been a long time since Ulutas and Ubuz (2008), Yucedag (2010), Baki et al. (2011), Yalcinkaya and Ozkan (2012), Ciltas et al. (2012) and Tatar et al. (2013) completed their studies, it was seen that Kutluca et al. (2016) focused on graduate theses based on computer-assisted mathematics teaching, and Acikgul and Aslaner (2014) focused on studies related to computer-assisted mathematics teaching with prospective teachers. Considering this aspect, it is clear that different content analysis studies are needed in the field of mathematics education.

The problem of this research is 'What are the opinions of the teachers working in secondary education institutions about answer and solution based software?'

1.1. Purpose

The aim of this study is to determine the opinions of mathematics teachers in secondary education institutions in TRNC about the use of answer and solution based software by teachers and students in these institutions according to various variables. The aim of the study was to determine how effective some of the demographic characteristics of mathematics teachers were in determining their opinions

and to develop suggestions in this direction. It is thought that the suggestions to be developed for this purpose will provide a variety of ideas to teachers working in secondary education as well as to help them to realise the variables that affect their opinions on answer and solution-based software. In order to achieve this general purpose, the following sub-objectives have been identified:

1. Do teachers' opinions about answer and solution-based software show significant differences according to gender, age education level and academic year?
2. Do teachers' opinions on answer and solution-based software differ significantly from their postgraduate studies?
3. Is there a significant difference between the averages of teachers' opinions on answer and solution-based software?
4. Is there a meaningful relationship between teachers' opinions on answer and solution-based software? If so, at what level?

1.2. Importance of research

In order for students to be more active in mathematics lessons, instead of traditional teaching methods new teaching methods should be applied that involve students and attract them.

It is believed that the data collected with the research can be important in terms of exemplifying to teachers and students the use of computer as a tool in mathematics teaching with answer and solution-based software, demonstrating that they can use these software in solving mathematics problems, providing resources for future studies and being able to identify problems related to computer-assisted mathematics.

2. Method

In this research, general screening model from descriptive research methods is used. The general screening model is a screening arrangement made on a whole universe or a group or sample taken from the universe in order to reach a general judgment about the universe consisting of many elements (Karasar, 1994). The universe is composed of mathematics teachers working in the secondary education institutions of the Turkish Republic of Northern Cyprus Ministry of National Education, Youth and Sports. The information obtained from the questionnaires filled and returned by the mathematics teachers who were sampled, processed individually by the researcher into the data coding tables. The analysis of the obtained data were made by using SPSS package program on computer by applying frequency, percentage, arithmetic mean, standard deviation, t-test, analysis of variance (F-test) and Multiple Comparison Statistical Analysis results were obtained by applying LSD test.

2.1. Data collection tool

The data collection tool was controlled by one professor, two assistant professors and two experts who were experts in their fields and the survey was finalised according to expert opinions. The questionnaire developed is of 5-Likert type. The dependent variable of the research is the opinions of teachers about answer and solution-based software. The independent variables consist of demographic data. The three-part questionnaire consists of questions about demographic information, teaching methods used in the classroom and 34-item answer and solution-based software. The Cronbach Alpha reliability coefficient for answer-based software was 0.81 and the Cronbach Alpha reliability coefficient for solution-based software was 0.82.

3. Findings and discussion

3.1. Findings about demographic characteristics of mathematics teachers

Table 1 shows the frequency and percentage distributions related to mathematics teachers' demographic characteristics. Of the mathematics teachers, 53.8% (57) were female and 46.2% (49) were male. Of the mathematics teachers who make up the universe 19.8% (21) are 30 years old and under, 21.7% (23) are 31–35 years old, 31.1% (33) are 36–40 years old and 27.4% (29) are 41 years and older. Frequency and percentage distributions of mathematics teachers according to educational background are given. 30.2% (32) of the mathematics teachers have bachelor's degree and 69.8% (74) of them have master's degree. Frequency and percentage distributions of mathematics teachers according to academic years are given. 54.7% (58) of the mathematics teachers have 0–15 years and 45.3% (48) of them have 16 years or more working time.

Table 1. Findings about gender age, educational status academic years

		N	%
Gender	Female	57	53.8
	Boy	49	46.2
Age	30 and under	21	19.8
	31-35	23	21.7
	36-40	33	31.1
	41 and over	29	27.4
Level of education	License	32	30.2
	Master's Degree	74	69.8
Academic years	0-15 years	58	54.7
	16 years and over	48	45.3

22.6% (24) of mathematics teachers have some, 69.8% (74) have well and 7.5% (8) have very good computer skills. 17% (18) of the mathematics teachers have 6 years and under, 64.2% (68) have 7–9 years and 18.9% (20) of them have 10 years or more computer using time. 37.7% (40) of mathematics teachers stated that they are from courses or seminars and 36.8% (39) of them are from in-service trainings. 11.3% (30) of the mathematics teachers do not have and 88.7% (94) of them have the opportunity to use computers in the classroom. In addition, they stated that there is an internet and computer laboratory in all schools where they teach mathematics. Mathematics teachers stated that 97.2% (103) of them wanted to use computers in mathematics teaching and 2.8% (3) of them did not. To the question whether they want computer-assisted education in mathematics teaching or not, 72.6% (77) of mathematics teachers said 'yes' and 27.4% (29) of them said 'no'. 77.4% (82) of the mathematics teachers stated that computer assisted training in mathematics teaching is in the teaching hours and 22.6% (24) of them stated that it is outside the teaching hours.

3.2. Findings about mathematics teachers' opinions on answer based software in mathematics teaching

The opinions of mathematics teachers on answer-based software in mathematics teaching: 'It is very useful to try to solve a new math question using answer based software' ($\overline{X}$ = 3.98, SD = 1.0); 'In terms of visuality, answer-based computer software is essential in mathematics teaching' ($\overline{X}$ = 3.85, SD = 1.01); 'I would like to use classical mathematics teaching methods instead of answer based computer software' ($\overline{X}$ = 3.81, SD = 1.33). Opinions of mathematics teachers: 'I believe that answer based computer software will attract students' interest in mathematics teaching' ($\overline{X}$ = 3.80, SD = 1.03); 'In mathematics teaching, answer-based computer software should be used in conjunction with interactive computer assisted lectures' ($\overline{X}$ = 3.83, SD = 0.93); 'In mathematics teaching, answer-based computer software should be used together with solution-based software' ($\overline{X}$ = 3.87, SD = 1.13). In a study, Freeman (2012) emphasised that a calculator style answer-based software program

called HELP Math increased students' mathematics self-efficacy and achievement. In addition, Safdar et al. (2011) stated that the use of ICT in mathematics lessons in secondary schools is advantageous compared to the traditional method. It can be said that this is in line with the above results.

The opinions of mathematics teachers at the point of indecision: 'I hate to use answer-based software in mathematics teaching' ($\overline{X}$ = 2.99, SD = 1.18); 'I would like to consider the answer-based software when preparing a mathematics lesson plan' ($\overline{X}$ = 2.99, SD = 1.18); 'Using answer based software with computer in mathematics is a laborious task' ($\overline{X}$ = 2.89, SD = 1.16); 'In the future, I will use answer-based computer software effectively in mathematics teaching' ($\overline{X}$ = 3.20, SD = 1.08); 'I am sure that I will learn a computer language in order to write answer-based computer software to be used in mathematics teaching' ($\overline{X}$ = 3.23, SD = 1.26). It is parallel to these results that similar studies done with computer support put additional burden on teachers (Baki & Birgin, 2004).

3.3. Findings about mathematics teachers' opinions on solution-based software in mathematics teaching

The opinions that mathematics teachers agree at the highest level: 'I think that solution-based software is useful in mathematics' ($\overline{X}$ = 4.46, SD = 0.82); 'I especially enjoy using solution-based software in mathematics' ($\overline{X}$ = 4.20, SS = 1.17); 'I am confident that I will be able to teach better using solution-based software with the help of computer when teaching mathematics' ($\overline{X}$ = 4.23, SS = 1.05). According to the opinions of the mathematics teachers the items at 'I agree' level: 'Trying to solve a new math question using solution-based software is very useful for students' ($\overline{X}$ = 4.01, SD = 0.09); 'I would like to consider solution-based software when preparing mathematics lesson plan' ($\overline{X}$ = 4.04, SD = 0.83); 'I believe that solution-based computer software will attract students' interest in mathematics teaching' ($\overline{X}$ = 3.96, SD = 0.93); 'In the future, I will use solution-based computer software effectively in mathematics teaching' ($\overline{X}$ = 4.19, SD = 1.08); 'Solution-based computer software and computer based interactive lectures should be used together in mathematics teaching' ($\overline{X}$ = 3.91, SD = 1.00); 'I believe that solution-based computer software will increase students' mathematics achievement' ($\overline{X}$ = 3.78, SD = 0.96); 'Using solution-based software with computer in mathematics is a laborious task' ($\overline{X}$ = 3.62, SD = 1.13).

In a study, Freeman (2012) emphasised that a calculator style answer-based software program called HELP Math increased students' mathematics self-efficacy and achievement. In addition, Safdar et al. (2011) stated that the use of ICT in mathematics lessons in secondary schools is advantageous compared to the traditional method. In addition, it is parallel to these results that similar studies done with computer support put additional burden on teachers (Baki & Birgin, 2004).

According to the opinions of mathematics teachers, the opinion they remain at the point of indecision is 'I do not think that solution based computer software can provide convenience in mathematics lesson' ($\overline{X}$ = 3.38, SS = 1.01). This indicates that the issue is new and needs to be supported by experimental studies. The opinion that mathematics teachers do not agree is 'Solution-based computer software directs students to memorise' ($\overline{X}$ = 2.32, SD = 1.13). Rather it is understood that solution-based software does not directs to memorise.

3.4. Findings and comments on the relationship between teachers' opinions about answer and solution-based software

One of the sub-problems of the research is 'Is there a significant difference at 0.05 level between the teachers' opinions about answer and solution-based software?' A paired Pearson correlation test was performed to find an answer to the problem and there was a relationship between the groups.

Table 2. Findings regarding relationship between teachers' opinions about answer and solution-based software

Groups	*N*	$\bar{X}$	SD	*r*	*p*
Answer-based software		59.82	9.34	0.80	0.01
Solution-based software	106	62.54	9.07		<.05

As can be seen in Table 2, there is a statistically significant relationship between the opinions of mathematics teachers towards answer and solution-based software ($r = 0.80$, $p < 0.05$). According to this result, teachers want to use the answer and solution-based software simultaneously. In their answers to an open-ended question asked to teachers, they first stated that they wanted to use solution-based software and then answer-based software.

They stated that students should use solution-based mathematics software to reinforce the subjects during the semester and answer-based software should be used to test themselves.

4. Conclusions

Most of the mathematics teachers have a master's degree. Mathematics teachers mostly have good and very good computer skills. Mathematics teachers said that their computer skills are good and very good due to courses, seminars and in-service trainings. The majority of mathematics teachers have the opportunity to use computers in the classroom. In addition, they stated that there is an internet and computer laboratory in all schools where they teach mathematics. Most of the mathematics teachers stated that they want to use computers in mathematics teaching. Math teachers want computer-based and supported education in mathematics teaching. Most of the mathematics teachers stated that computer-assisted training in mathematics teaching is in the teaching hours and very few of them stated that it is outside the teaching hours.

Mathematics teachers stated that it is useful to try to solve mathematics questions by using answer-based software as the opinion they have participated at the highest level. In addition, they wanted to use answer-based computer software in terms of visuality in mathematics teaching while they continue to use classical mathematics teaching methods. According to the opinions of mathematics teachers, they believe that answer-based computer software will attract students' interest in mathematics teaching. They agree that answer-based computer software should be used together with interactive computer-assisted lectures in mathematics teaching and that education programs should be changed in order to achieve this.

They stated that answer-based computer software should be used together with solution-based software in mathematics teaching. They were undecided about whether using answer-based software with computer in mathematics as a laborious task or not, and whether they would be able to use answer-based computer software effectively in mathematics teaching in the future. It is parallel to these results that similar studies done with computer support put additional burden on teachers (Baki & Birgin, 2004).

The opinions that mathematics teachers fully agree on solution-based software in mathematics teaching at the highest level are that solution based software is useful in mathematics; they especially enjoy using solution-based software in mathematics; and they are confident that they will provide better education by using computer-assisted solution-based software while teaching mathematics.

According to the views of mathematics teachers, the items at 'I agree' level are that it is useful to solve mathematics questions using solution based software; they want to consider solution based software while preparing mathematics lesson plan; they believe that solution-based computer software will attract students' interest much more in mathematics teaching; and they believe that in the future, they will use solution-based computer software effectively in mathematics teaching and increase students' mathematics achievement.

In a study, Freeman (2012) emphasised that a calculator style answer-based software program called HELP Math increased students' mathematics self-efficacy and achievement. In addition, Safdar et al. (2011) stated that the use of ICT in mathematics lessons in secondary schools is advantageous compared to the traditional method. In addition, it is parallel to these results that similar studies done with computer support put additional burden on teachers (Baki & Birgin, 2004).

The opinion that mathematics teachers remain at the point of indecision is that 'I do not think that solution-based computer software can provide convenience in mathematics', which indicates that the subject is new and should be supported by experimental studies.

From the opinions of mathematics teachers, it is understood that solution-based computer software does not directs students to memorise. There is a statistically significant difference between the opinions of mathematics teachers about answer and solution-based software and according to this result, teachers want to use solution based software more. In addition, the averages of 59.82 and 62.54, indicating that they want to use both softwares are at 'I agree' level according to the total grade range given over 85.

Mathematics teachers want to use the answer- and solution-based software simultaneously. In their answers to an open-ended question asked to teachers, they first stated that they wanted to use solution-based software and then answer-based software and stated the reason as: Students should use solution-based mathematics software to reinforce the subjects during the semester and answer-based software should be used to test themselves.

5. Recommendations

According to the results of this research, the recommendations for future research are as follows: Solution-based software and answer-based software can be applied in different lessons. This study, which is consulted by mathematics teachers, can be also done with students. Mathematics teachers can take in-service training with solution-based approaches. Experimental studies for solution-based approaches can be increased.

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