American Journal of Applied Sciences 5 (11): 1506-1517, 2008
ISSN 1546-9239

A Study of Mathematics Web-Based Learning in Schools

Mansoor Al-A'ali
Department of Computer Science,
College of Information Technology, University of Bahrain, P.O. Box 32038, Bahrain

Abstract: Teaching Mathematics to intermediate school boys is a challenging process which can greatly benefit from software technology and web-based learning. In this research we study the difficulties and opportunities of using this technology in teaching Mathematics to 13 year old boys studying Mathematics at school. For students' we identify the basic requirements at home, e.g., Mathematics computer software packages, availability of internet access and ability of the parents to provide computers, software and the internet for their sons. We assess the expected improvement in grades, motivation and communication between home and school. For the teaches', we assess the expected improvement in teachers' productivity, teachers' experience, qualifications in computing and Mathematics packages and their anticipated expectations such as improvement in problem solving, grades of students. Our main objective is to determine the expected results resulting from applying computer software and web-based learning in teaching Mathematics.

Key words: Mathematics computer education, evaluation, learning and teaching, software, education

INTRODUCTION

The introduction of information technology in recent years has provided the opportunity to integrate alternative learning techniques into traditional teaching[35]. Learning or teaching systems have been developed in a bid to improve the teaching process. Software classified as drill-and-practice significantly improved achievement test scores. The internet also began to have significance for professional communication among teachers. Sixteen percent of teachers communicated with peers outside their buildings on professional matters. The rate rose to 33% for those who had Internet access at home and at school.

Expecting motivation and interest give us implication of future learning. Research studies that focused on technology and students' motivation to learn relied on self-reports of students' attitudes towards computers and found that most students considered computer activities to be highly motivating and interesting[8].

For the teachers' side, productivity is an important issue. Technology tools can free teachers' time so they can interact with students more. Teachers can leave fact-finding to the computer and spend their time doing what they were meant to do as content experts: Arousing curiosity, asking the right questions at the right time and stimulating debate and serious discussion around engaging topics.

Using technology to support collaborative knowledge integration includes tools that enable group thinking, problem solving and task orientation. Sharing data also offers the opportunity to share with a wider and more authentic audience. The goal is to help students develop community knowledge bases and expertise instead of focusing only on individual student learning. Shared data leads to larger and more accurate data sets. Sharing real data from primary sources with experts leads to students thinking and working the way experts do[23].

Several studies have been undertaken to investigate the impact of computer software in order to evaluate their effectiveness. The UK studies include an evaluation of an integrated learning system introduced into a small sample of schools to support the teaching of basic numeracy and reading. The introduction of a particular software can result in substantial gains for pupils in acquiring numeracy skills. There is considerable disagreement over the extent to which software has been effective in raising achievement. Nevertheless, there does appear to be limited evidence that the way in which software is integrated into the curriculum and the amount of time spent on the system, has some influence on its effectiveness.

Corresponding Author: Dr. Mansoor Al-A'ali, Department of Computer Science, University of Bahrain, P.O. Box 32038, Kingdom of Bahrain Tel: +973-39607724

Emergence into the 21st century features tools that are different, communication that is different, information that is different and work that is different. Given this shift, education must shift to incorporate computer-based, electronic technologies integrating learning with these technologies within the context of the academic subject areas. However, how teachers learned their subject matter is not necessarily the way their students will need to be taught in the 21st century. Learning subject matter with technology is different from learning to teach that subject matter with technology. Few teachers have been taught to teach their subject matter with technology[31].

Intelligent tutoring systems (ITS) provide individualised instruction, by being able to adapt to the knowledge, learning abilities and needs of each individual student. Existing ITS build a model of the student's current state of knowledge and individualise instruction based on that model[31,32]. Intelligent tutoring systems offer many advantages over the traditional classroom scenario: they are always available, non judgmental and provide tailored feedback[15]. They have been proven effective, resulting in increased learning[2].

Intelligent tutoring environments for problem solving have proven to be highly effective learning tools. Many of these environments present complex, multi-step problems and provide the individualized support that students need to complete them: step-by-step accuracy feedback and context-specific problem solving advice. They are two or three times as effective as typical human tutors, but only half as effective as the best human tutors, which can improve student learning by two standard deviations. This means there is still room for improvement, which can be accomplished by making the interfaces more suitable and effective for learning in certain domains. Cognitive Tutors are a class of intelligent tutoring systems that are designed based on cognitive psychology theory and methods that pose authentic problems to students (learn-by-doing). In Cognitive Tutor Algebra, students represent the situation algebraically in the worksheet, graph the functions and solve equations with a symbol manipulation tool. Each Cognitive Tutor is constructed around a cognitive model of the knowledge students are acquiring and can provide step-by-step accuracy feedback and help[31]. They have been created for a variety of learning domains, including algebra, geometry, foreign languages, chemistry, computer programming and more. Cognitive Tutors for Mathematics are in use in about 2000 schools in the United States and have been shown to raise student achievement one standard deviation over traditional classroom instruction.

It is generally agreed that technology can contribute to the teaching methods and the learning process and can enhance the students abilities by providing them with the tools to iterate similar and different questions and solutions. Software for teaching is a big industry but not enough efforts have gone into creating awareness in schools and for teachers to further utilize technology. Developing countries have even bigger issues with utilizing software and web-based learning due to many reasons, e.g., funding problems. This research investigates some important aspects relating to using software packages and web-based learning to teach Mathematics to 13 year old intermediate school boys in a typical government Bahraini school.

TEACHING MATHEMATICS and SOFTWARE PACKAGES

The introduction of technology resources into Mathematics classrooms promises to create opportunities for enhancing students' learning through active engagement with mathematical ideas; however, little consideration has been given to the pedagogical implications of technology as a mediator of Mathematics learning[4,17,21,26].

A model which includes specification of mathematical ideas (computer objects or manipulatives) and processes/skills (software "tools" or actions) and extensive field-testing from the first inception through to large summative evaluation studies was presented in[4]. The initial field test results indicate that such an approach can result in significant assessed learning gains[4]. Computer software and web-based learning are valuable resources in the teaching and learning process in Mathematics. Learning outcomes are producing the desired innovation in educational programs[19].

One of the most important goals of Mathematics is problem-solving skills. High school algebra and geometry students who used commercially available problem-solving software scored significantly higher on tests of Mathematics content than groups of students who did not use the software. The students using the software also made significant gains in problem-solving ability[5].

When developing software to teach Mathematics, the design and development model should draw from theory and research in each phase. The design process should be based on the assumption that curriculum and software design can and should have an explicit theoretical and empirical foundation, beyond its genesis in someone's intuitive grasp of children's learning[30]. It also should interact with the ongoing development of

theory and research-reaching toward the ideal of testing a theory by testing the software and curriculum in which it is embedded[30]. The design model should include specification of mathematical ideas (computer objects or manipulatives) and processes/skills (software tools or actions) and extensive field-testing from the first inception through to large summative evaluation studies[30].

Within Mathematics education, classroom teachers, educational researchers and instructional designers share the common goals of understanding and improving the teaching and learning of Mathematics. Teachers work to help students learn; researchers study how people learn and teach Mathematics; and designers develop instructional materials to support teachers and students[25]. Each community (of teachers, of researchers and of designers) develops its own perspectives, methods and expertise.

Most work in Mathematics education falls into one of three categories: classroom teaching, educational research, or instructional design. Practitioners in these three fields share the common goals of understanding and improving the teaching and learning of Mathematics[25]. Teachers work to reach each student. Researchers work to understand more about teaching and learning. Designers work to develop usable materials. Yet, too often, their best efforts fall short. Research that is compelling to researchers may seem irrelevant to teachers. Carefully designed instruction may fall flat when brought into the classroom. Teachers' lack of research knowledge or lack of access to appropriate materials may impede their efforts to reach all students.

Most American Mathematics educators devote their professional lives to one of these categories: they teach students or they develop materials or they do research. Unfortunately this focus limits practitioners' perspectives as well as their resources. Despite their common goal of improving Mathematics education, members of these three communities collaborate far too seldom[10].

Many efforts have been made to explore alternative ways of teaching Mathematics by creating curricula and didactic material that incorporate new tools, pedagogical approaches and models or methods, which engage learners in a more pleasant, Mathematical learning process.

Through the use of new technologies in the classroom, there is promising evidence of a relationship among computer-supported recreational activities, positive attitudes towards Mathematics, improvement in mathematical learning and student performance.

The problem of Mathematics learning is always a major concern for most teachers. While students cannot thoroughly realize the characteristics and meanings of math symbols, it is unreasonable to ask students to simulate or recite their arithmetic calculations. For deep learning, students need to learn how to make and provide explanations for their solutions not just learn how to calculate. Therefore, there is no routine to enable students to solve math problem automatically[40].

Technology is used as a mindtool that can be used to support the deep reflective thinking that is necessary for meaningful learning. The use of computers in education can be utilized as a new technological support for the visualization of abstract concepts through computer-generated virtual representations, allowing for the generation of mental models of the concept. With computer software, students can interact with educational material designed to develop the skills necessary to solve everyday situations by using their mathematical background[9]. Nevertheless, the ludic component in the instruction of Mathematics has acquired relevance due to its ability to engage learners in Mathematics, either through ludic learning environments or introducing mathematical games into the classroom. The use of a recreational context, where students are presented with a problem as part of a playful situation, represents one approach in the design of educational software. Learning can be improved if the student builds his/her own learning environment, as Gros[9] pointed out. However, this approach requires a strong commitment on the part of the student in order to acquire and develop the required skills necessary to become a Microworld-specialized computer programmer, reducing the number of potentially successful students.

As information technology continues to progress, teaching mathematic with multimedia is becoming a new way of instruction. Nevertheless, before this new way of instruction is feasible and practicable, a challenge should be taken into account. The challenge is how mathematical symbols and processes of writing solutions can be easily expressed on the web. Writing mathematical fractions is not an easy task on the Internet[39].

In traditional teaching, to assess whether students have understood a mathematical problem is based on whether they could describe the correct arithmetic procedure. However, it is not enough to evaluate students Mathematics concepts and abilities of solving math problems merely depending on their writing. Some oral interpretation and explanation should be considered from multiple assessment points of view. Multimedia whiteboard system provides students both

writing down procedures and recording oral explanations during students engaging in math problems solving.

The usefulness of designing computer games to teach Mathematics can be found in the project, Electronic Games for Education in Mathematics and Sciences, E-GEMS (http://www.cs.ubc.ca/nest/egems/index.html) of the Canadian University of British Columbia. E-GEMS is intended to motivate students to learn Mathematics and science through the use of computer games. The project analyzes the ways in which interface design affects learning, game preferences by gender[7] and the use of multi-player games for collaborative learning. Members of the project consequently developed several independent educational computer games, some of which are available commercially. An electronic collaborative learning environment based on Interactive Instructors of Recreational Mathematics (IIRM), establishing an alternative approach for motivating students towards Mathematics was introduced by Lopez-Morteo[24]. The IIRM are educational software components, specializing in mathematical concepts, presented through recreational Mathematics, conceived as interactive, recreation oriented learning objects, integrated within the environment.

The vision of computer-supported Mathematics and a system which provides integrated support for all work phases of a mathematician has always fascinated researchers in artificial intelligence, particularly in the deduction systems area and more recently in Mathematics as well[16].

WEB-BASED LEARNING

Internet helps teachers to communicate; one of the communication methods is sending and receiving emails. The use of computers and computer networks as communication tools by teachers who are collaborating with each other to achieve a shared goal, which does not require the physical presence or co-location of participants and which can provide a forum for continuous communication free of time constraints[18,29].

It is accepted now that the internet has changed the education learning environment during the past decade[20], [14]. People expect Web technology to facilitate learning. A key issue involves the factors motivating the adoption of the Web for learning[13]. Using Web technology in education can influence learning behavior by providing an effective learning environment that encourages more active participation, offering opportunities for responsive feedback and individual involvement and promoting teamwork through collaborative learning[6]. The transformation from traditional classrooms to web-based learning environments has changed learning styles and interactions between instructors and students[1]. Web technology can enable students to communicate electronically and attend courses online. Further, trainers can work in cyberspace to improve educational inputs, process and outcomes[38]. The growth of Web applications has made the Web an important educational medium[34].

The number of internet applications of Mathematics software is growing quite dramatically. Most notably, applications such as scientific visualization, distance collaboration, tele-learning, etc., allow users from different backgrounds to share information over the network. Web-based learning thus is a goal-directed human behavior underlying community networks that sustain interaction among students, instructors and web-based systems[12]. The literature has identified the usefulness and ease of use of web-based systems for learning[33,27]. However, overemphasizing the effectiveness of web-based systems may ignore the cognitive processes of learners in their adaptation learning behavior[22]. As a result, the mechanism used by human agents to respond to web-based learning environments was lacking and still needs to be addressed.

Unlike learning in traditional classrooms, web-based learning presents learners with a new environment, one which they may either accept or reject depending on their adaptation of the learning process[22]. Whether human agents can learn more effectively in web-based learning environments compared to traditional classrooms depends on how the evolution of community networks can sustain collaboration, develop trust between students and instructors and encourage active participation in student-instructor interaction[3], [11], [36].

A design and preparation using hypermedia tools of an interactive CD-ROM for the active teaching and learning of diverse problem-solving strategies in Mathematics for secondary school students was presented in Sa´ nchez *et al*.[17]. The prototype interactive CD-ROM, which is the basis of the study, is designed to facilitate students' ability to use heuristics to solve problems[17]. There is growing consensus, regardless of the theoretical model adopted on the mechanisms generating the information process, that if one receives a good classification and structuring of mathematical information, this will facilitate deeper learning and, therefore, more efficient learning. Also it is important to achieve the efficient coding of

information, whether verbal, symbolic formal or in the form of an icon. In this way the interaction process between the external and internal representations of the knowledge is boosted and, with it, the efficiency and efficacy of the learning process.

WeBWorK, an open-source web-based homework program used largely in postsecondary Mathematics and science courses, with recent extension to high school courses[37]. WeBWorK draws from a large library of problems to generate individual assignments and provides immediate feedback about correctness of students' answers. WeBWorK allows entries in multiple choice, formula and numerical formats. The entries recorded by the system create an extensive database of student interactions with the system.

A web-based multimedia whiteboard system to help students learning with mathematical problem solving was presented in Hwang *et al*.[40]. To cultivate students critical thinking capability and encourage collaborative peer learning, the new learning model also requests students to criticize others solutions and reply to others arguments. With the multimedia supporting tools, students can communicate easily with each other about what they think and how they solve mathematical problems. Hwang *et al*.[40] conducted an experiment with sixth grade primary school students for evaluation.

Preservice teachers' pedagogical content knowledge (PCK) development was investigated with respect to integrating technology[28]. The study examined PCK of student teachers in a multi-dimensional science and Mathematics teacher preparation program that integrated teaching and learning with technology throughout the program.

The use of web-based learning has received a great deal of attention and has been researched from a variety of perspectives. However, the basic issues facing developing countries pertaining to the use of the internet, Mathematics software packages has not been researched enough. Unless the internet technology coupled with the carefully developed Mathematics teaching packages are applied, developing countries will continue to stay behind in utilizing this important human achievement.

RESEARCH OBJECTIVES

Three years ago, the King of Bahrain ordered that all government schools in Bahrain must implement the e-learning technology. Since then the Ministry of education has been working on this project and has initially identified a number of schools for this project. Schools involved in the e-learning project receive all the support needed in the form of computers, software, technicians and some training for the teachers involved. However, the e-learning drive is in its infancy and is bogged down with many issues such as setting up the e-learning environment, setting up labs, making teachers computer literate and placing teaching software and student follow-up systems. The use of specialized software to teach subjects such as mathematics is clearly an area to be researched in order to identify and resolve obstacles.

This research is focused on the Mathematics subject for the first year Intermediate school for boys in order to identify the level of computer and internet readiness and obstacles of these students at home to benefit from the Mathematics teaching software. The research also examines the readiness and knowledge of the Mathematics teachers at the school to utilize this technology for the benefit of the teaching process. The overall aim of the research is to identify the issues which need to be resolved to enable the teachers and the students to use these web-based software tools/packages. After carefully studying the literature, we can state that these issues have not been studied especially for our region of the world.

RESEARCH METHODOLOGY

Our research methodology for evaluating the use, benefits, limitations and obstacles relating to the use of Mathematics software packages in the boys intermediate schools in Bahrain was primarily based on two carefully prepared sets of questionnaires, one questionnaire for the parents and one for the teachers of Mathematics. Bahrain has abundance of different school education ranging from free public government schools run by the Ministry of education, to private local and international schools. Most of the parents with average to low income send their children to the government schools. Almost all intermediate schools have computer labs which could be used for teaching. Our first task was to review the literature to evaluate the use of Mathematic software to support in Mathematics teaching and how the web-based learning can be used for this purpose. We then prepared two sets of carefully developed questionnaires: one for the parents and one for the school Mathematics teachers.

We conducted a survey of the parents to investigate their acceptance, understanding, initial knowledge of computers and their application in teaching. A total of 30 parents were surveyed and all filled the questionnaire. The parents were of different levels of income and education. Another questionnaire was given to the Mathematics teachers test their readiness, willingness, knowledge and belief in using this technology.

At first we thought of giving the questionnaires to students, but 13 year old students in the intermediate level would not be able to answer such a questionnaire and hence it was decided that their parent would be a better target for the survey. Parents are careful about their sons learning and they will give answers in their sons best intgerests.

The teachers' questionnaire was developed to identify a number of outcomes in relation to the process of teaching Mathematics at the school:

- Level of knowledge of web-based Learning and software
- Measure of teacher productivity through using and introducing web-based learning and software
- Level of teacher experience of some packages in Mathematics
- Teachers' literacy in Computers
- Teachers problem-solving expectation from the software
- Teachers expectation in the improvement in students' grades as a result of using Mathematics software and web-based learning
- Source of responsibility of preparing software and web materials
- Computer software and web-based learning Cost
- Effect of the gap between wealthier and poorer in school after implementing the web-based software
- Importance of English language for the students in using computer software and web-based learning

In order to ensure the teachers give correct answers to the questionnaire, we conducted a number of seminars about web learning and demonstrated some packages.

The parents' questionnaires were not of technical nature, but rather focused on aspects such as:

- The current grade averages of students for the last three years
- Expected improvement as a result of using the Mathematics web-based software packages
- Percentage of internet access at homes
- Expected motivation in students as a result of using the Mathematics web-based software packages
- Expected time management for the students as a result of using the Mathematics web-based software packages
- Parents ability to understand students improvement as a result of using the Mathematics web-based software packages
- Undesirable aspects as a result of using the Mathematics web-based software packages
- Parent's ability to provide tools for software and web-based learning

The data was collected for one intermediate school for boys. All school teachers and parents were allowed to participate in the questionnaire. The study gathered data from one Mathematics classroom. The reason for choosing to apply the research on one classroom is to get a real understanding of the status of group of students who share the same school, classroom, teachers and average financial status.

PARENTS' QUESTIONNAIRE

The following points present the parents questionnaire results and analysis.

Expected improvement in grades as a result of using computer software and web-based learning: One of the first tasks of the research was to identify the achievements/scores of these students over the last three years. The grades awarded to students are categorized as: excellent, very good, good, average and fail, (Table 1). The results are the average scores in all Mathematics subjects over the last three years. The distribution shows an overall even distribution of grades. We have to understand here that these students come from low to average income families. We also have to understand that the results of school boys in this age group are generally low in all subjects.

The highest percentage of parents, 40%, expected 10 to 15% improvement in the grades in their sons' marks in Mathematics if computer software and web-based learning is used, (Table 2). The second highest percentage, which is 33% of parents, expected 5 to 9% improvement in grades. A total of 17% of parents thought that the improvement would be below 5%, while 3% of parents expected 16 to 25% grades improvement in Mathematics. The same percentage expected an increase of above 25% grades. The majority of the parents do not have university qualifications, but the results show that the majority of them believe in using software to help their sons. We believe that the reason why 17% of the parents could

Table 1: Average students' level in Mathematics for the last 3 years (parents' perspective)

Scores %	Grade	Frequency	(%)
90% and above	Excellent	4	13
80 to 89%	Very good	3	10
70 to 79%	Good	4	13
60 to 69%	Above average	6	20
50 to 59%	Average	5	17
Below 50%	Fail	8	13

Table 2: The expected increase in students' grade in Mathematics as a result of using compter software and web labsed learning (parents' perspective)

Expected increase in grades as a result of using software & web-based learning	(%)
More than 25	3
16 to 25	7
10 to 15	40
5 to 9	33
Below 5	17

Table 3: Percentage of internet access at homes

Internet access	(%)
Have internet access	55
No internet access	45

not foresee a major improvement in the grades could be either because their sons are already of high standard or are not academically oriented anyway.

Student using software, internet access and email: Although the figures shown in Table 3 understandably will improve with time, currently 45% of all students do not have access to an internet at home. These students probably go to internet cafes or do not use the internet at all. However, this is not to say that they cannot use a software package installed on their computer for learning Mathematics. Even if some parents might not be aware of the internet, their sons would know and would push for such service. However, the cost of running the internet could be prohibiting to some parents (currently averages around $50 per month) and would rather do without it or take their son to the internet café.

Expected motivation in students through the use of computers: When asked about the expected motivation for their sons to use Mathematics software and web learning software, parents expected that 15% of the students would read more material about Mathematics other than the curricula text. The higher percentage, 85%, expected that the students would read only the text they have. The fact that the majority of parents thought their sons would not be motivated by the software to learn and practice more could be due to their ignorance of the joy of using such packages to present a teacher at home set up, or simply because they think that Mathematics is logic based and only a teacher can make it clear. This shows that parents need to be informed about the benefits of such software.

Responsibility and time management using web-based learning at home: The questionnaire shows that 43% of parents expected their sons to manage their time properly, see Table 4. The higher percentage of parents,

Table 4: Expected time management and exercising for the students

Grades	(%)
Revising and exercising	43
Playing games and others	57

Table 5: Parents' ability to provide requirements

Computers and Software	(%)
PC only	75
PC, software only	60
PC, software and internet access	55
Cannot afford any of the above	10

57%, expected their sons to play games or other internet activities such as chatting. Although this may appear to be a negative result, it is our belief that once the facility is available, students would use it especially for revision before the exams.

Expected negative effects in using software and web-based learning: We asked the parents to write any expected negative results they expected from their sons as a result of using computers and web-based learning. We selected some of what they wrote:

- The student may stay home all the time and not have outdoor activities
- I need to buy computers for all my sons and daughters. I can not afford that
- We can not watch our son all day. He could use the internet for wrong purposes
- The student might chat with his friends and ignore his lessons

It is the aim of this research to deal with social issues relating to the internet and in any case these results are not permanent since technology would progress and would become the norm. However, the issues raised by parents need to be addressed in a way to help the students.

Parent's ability to provide tools for software and web-based learning: Most parents, 75%, are capable of providing the basic requirement which is computer, (Table 5). A few parents, 10%, cannot afford to provide computers, software or the internet. In order to help the parents give the correct answer, the question gave average costs of computers, some Mathematics software, internet prices, frequency of replacing computers, etc.

TEACHER QUESTIONNAIRE WEB-BASED LEARNING AND SOFTWARE

Teachers are the key to the learning process regardless of the technology. However, we need to

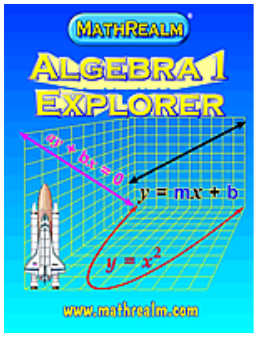

Fig. 1: An example of a Mathematics software package called "Algebra Explorer"

Table 6: Productivity and work load expectation from teachers

Grades	Frequency
Productivity contributions and work load increase	75
Same work load	15
More work load	15

know the level of awareness amongst teachers about using the technology, such as the web and software packages to help in the teaching and learning process. We know that currently, teachers are not obliged to know about web learning or how to utilize the Mathematics packages in their teaching process, (Fig. 1). The teachers are of mixed ages ranging from 25 to 57 years of age. In order to guarantee that the teachers are aware of the technology in general and the potential of using the web learning concept in Mathematics and to the year they teach, we gave them seminars about web learning and demonstrated some packages.

Teacher productivity: Most teachers, 75%, expected that their productivity would improve as a result of using the technology, see Table 6. Some teachers linked using the technology with an increase in their work load.

We asked the teachers to write the reasons why they thought that web-based learning would contribute to productivity and work load, they gave the following typical answers:

- Computer will help us evaluate the student more efficiently
- A lot of reports would be generated automatically such as students' weakness in Mathematics
- Computers software and web-based learning will make students work by themselves and give them motivation and thus make our work easier
- Easy to use computer tools will help us to illustrate difficult lessons

Table 7: Teacher using Mathematics packages

Grades	(%)
Use mathematics packages	20
Do use mathematics packages	80

Table 8: teachers certification in computer

Grades	(%)
Diploma in any computer software	7
Basic Ms Office	90
Nothing	3

- Students will be attracted by multimedia which will make them concentrate and understand with less effort on our behalf
- Teacher can share their work and experience

It is clear from Table 6 that the majority of teachers are already convinced of the benefits of using the web-based learning and see it as a positive contribution and a welcome help.

Teacher experience of some packages in mathematics: Only 20% of teachers used Mathematics packages for the course level they teach, but not necessarily at school. 80% of teachers have not worked with Mathematics packages at all. When asked about the reason for not using the packages, the most common reasons they quoted were: the software is expensive, the software is difficult to find and buy, they are not aware of such packages. We can conclude from the results shown in Table 7 that the school needs to have an awareness program for the Mathematics teachers by sending them on seminars or purchasing the software for them and training them on using it. Unless the teachers realize the benefits of the software and are made truly aware of the web-based learning, the students would not be guided properly in this direction and the technology would go a miss.

Teachers' literacy levels in computers: Table 8 shows that 7% of the Mathematics teachers have a basic diploma in computers which covers basics aspects of computing, 90% of teachers have studied at least MS Office Package at basic level and 3% of teachers have no literacy in using computers at all. Although a teacher does not need to be certified in any package, but the fact that the majority only know basic MS office would stand in their way of gaining confidence and using specialized Mathematics packages or web-based learning.

Expected level of communication between home and school: The issue of communication between home and school is a vital one; 60% of teachers thought that communication between school and home would

Table 9: Problem-solving expectation

Grades	(%)
Better problem-solving skills	80
Not better	20

Table 10: Expected increases in students' grade

Grades	(%)
More than 25	0
Between 16 to 25	10
Between 10 to 15	50
Between 5 to 9	23
Below 5	27

Table 11: Where to invest money

Investment	(%)
Investing in computer software and web-based learning	63
Investing in basics	37

Table 12: Expectated gab between poorer and wealtier studentsif more emphasis is placed on using technology

Gap	(%)
Big gab	53
Some gab	37
Negligible gab	10

increase as a result of using web-based learning, while 40% of teachers thought that the communication would not increase and would be restricted between students and teachers. It is difficult to assess these answers at this stage, butthis issue can be monitored once web-based learning is put into action.

Developing better problem-solving skills: About 80% of teachers expected that students would develop better problem-solving skills when using computer software and web-based learning, (Table 9). The other 20% expected that students would not develop new or enhanced problem-solving skills. These are encouraging results since the majority is supportive and appreciative of the use of the software packages and web-based learning. The time constraint in the classroom would not normally give the student or teacher enough time to practice as many exercises, but, software would enable the student to practice as much as needed and this would consequently reflect on the problem solving skills.

Improvement in students' grades using Mathematics software and web-based learning: As a result of using the Mathematics software and web-based learning, 27% of teachers expected below 5% improvement in students' grades, see Table 10. A total of 23% of teachers thought that there would be an increase between 5 and 9%. Fifty percnet of teachers said that the increase would be between 10 and 15%. The rest of teachers, 10%, thought the increase would be between 16 and 25%. No teacher expected an improvement above 25%. It is interesting to note that the teachers gave similar expectations as the parents, (Table 2). In both cases, the majority expect reasonable improvements in grades.

Responsibility of preparing software and web materials: About 77% of teachers thought that the ministry of education will provide the software and web material for the both the students and teachers. Only 3% thought that the responsibility would be placed on the teachers. A total of 20% of the teachers considered that both the teachers and the ministry will cooperate in providing the material. Although it is possible to train the teachers or experts at the ministry to prepare basic software with some level of built in expertise, it is not possible to develop software of the required standard which matches the commercially available packages developed by international companies. The focus should be on training the teachers to use the software and the ministry would be responsible for the purchasing of the software and for the training aspect of it.

Computer software and web-based learning cost: When asked about the priority for spending money to improve the teaching of Mathematics, 63% of teachers thought that investing money in computer software and web-based learning is an excellent idea, whilst 37% thought that money should be spent supporting the traditional method of teaching, see Table 11. A total of 37% of teachers, who may appear at first glance as non-supporters of using technology, are really making a statement that basic teaching support is important and should be put first. This may be true for the next few years, but certainly would not hold in the future as using software and the web would become the norm and we expect the teacher to be the supporter of the software rather than the other way round.

Gap between wealthier and poorer students in school: This question measures the expectation of opportunities between poorer and wealthier students in education. Table 12 shows that 53% of teachers said that there would be a gap between poorer and wealthier students in school because the poorer students may not be able to purchase all the software required or be able to use the internet as much as they need to since the internet in Bahrain is charged by speed and amount of Gigabytes download. This places the burden on the ministry and the school to make sure that all the important software and internet access are provided to all students.

Table 13: The importance of English language in web-based learing

Grades	(%)
English is important	87
English in not important	13

Importance of English language in computer software and web-based learning: Although some Mathematics software packages exist in Arabic, the majority of these packages are In English or at least the working environment on the computer is in English. When asked about how important it is for the students to learn English to enable them to use these packages, 87% of teachers considered English language an important requirement to use computer software and web-based learning, 13% thought it was possible to learn without understanding much English language, (Table 13). The student at the 1st year intermediate school are 13 years of age and have only studied English as a language for about 3 h a week during the previous three years. If the software is in English with English menus and explanations, they would not benefit much from it. Therefore the focus should be on using Arabised versions of the software.

RECOMMENDATIONS

The research objectives were to evaluate the difficulties which may be met in utilizing web-based learning and software packages for teaching Mathematics at schools in Bahrain. The aim was not to identify the benefit of an individual software or technique, but to identify the different issues which must be addressed to put the technology into use. The research results indicate that a number of issues can be tackled to resolve the difficulties in order to maximize the benefits of the technology. We list below our recommendations based on the research finding which we believe if addressed professionally would contribute to the process of learning and teaching Mathematics for 1st year intermediate school boys:

- Conduct seminars for the Mathematics teachers to make them aware of the different Mathematics software available which can be used to help in the teaching process. The benefits of using these packages should be made clear to the teachers
- Train the Mathematics teachers on these software packages and make sure that the teachers incorporate the use of these packages in the teaching process in such a way that the pupils use them in a systematic manner for learning, revising and practicing
- In order not to create a gap between wealthier and less wealthy boys, the school should make available all relevant software decided by the Mathematics teachers. These software can either be web-based or stand alone on home computers
- Use Arabic software if available, otherwise use Arabised packages to make sure that the students get the maximum benefit and not feel alienated because of language issues. Even if the basic software is in English, at least basic descriptions, menus and reasoning should be done in Arabic. A deal can be reached with the international company producing the software to Arabise the software
- The choice of software should be decided as a joint effort between the Mathematics teachers and the Ministry of education
- An awareness program should be developed for reluctant parents to explain the benefits of using computers, software and the internet in the teaching process
- Monitor the improvement in grades in general and in relation to specific packages to help in the decision when purchasing an update of the software or a new software
- Establish a proper procedure and guidelines for incorporating and integrating the Mathematics software packages and the web-based learning into the syllabus and the teaching process. Although a certain degree of freedom should be given to the teachers to find their own way of utilizing the software, but a general procedure must be established to be applied throughout
- The experience resulting from using these software packages should monitored by teachers and discussed in a forum which should result in a progressive development of the syllabus, the methods of teaching, the uses of the software, the testing and assignments
- It is important that the software should be presented to the students in such a way that it is a helping tool in support of the teacher and should not be presented as a monitoring system to identify the students' level of commitment or ability in Mathematics.

CONCLUSIONS

This research has investigated the challenges and opportunities presented by using technology in the form of software packages and web-based learning to the 1st year intermediate school students. The specially prepared questionnaire to parents and Mathematics

teachers has identified the expected difficulties, benefits, improvements in the grades, teachers work load and financial implications to parents. The research concludes that despite certain limitations, the majority of teachers and parents are highly supportive of using the technology and believe that it would make substantial positive contribution to the Mathematics teaching process. The research has exposed the current lack of awareness on behalf of the school, teachers and parents on the availability of such software.

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