A Survey of Mathematics Teachers' Attitudes towards the Integration of Computer Technology and Their Beliefs Regarding its Impact on Their Effectiveness in the Classroom

By

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Running Head: TEACHERS' ATTITUDES AND BELIEFS ABOUT COMPUTER TECHNOLOGY INTEGRATION

A Survey of Teachers' Attitude towards Integrating Computer Technology and Their Beliefs Regarding its Impact on Their Effectiveness in the Classroom

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Abstract

This study investigates the attitudes of mathematics teachers towards integrating computer technology and their beliefs regarding the impact of this integration on their effectiveness in the classroom. Responses of 100 middle school mathematics teachers on an attitude survey using a questionnaire were analyzed to determine whether there is a difference between attitudes of teachers who use computers and those who do not and to investigate the teachers' beliefs regarding the impact of integrating computer technology on the type of mathematical content they teach, their pedagogical skills, and their ability to adapt the curriculum to the students' needs. All teachers participating in this study taught in either public or private schools in one of the two cities, Saida and Beirut, in Lebanon. The questionnaire was also complemented by structured interviews with eight teachers regarding the attitudes and beliefs about the integration of computer technology. Teachers' responses were collected, analyzed, and reported. Results showed that teachers using computer technology have more favorable attitudes towards its integration than those who are not. Also teachers believe that integrating computer technology has a positive impact on the type of mathematical content they teach and their ability to adapt the curriculum to their students' needs whereas, they believe that it does not affect developing their pedagogical skills. Some factors were significantly related to successful implementation of the computer technology and affected this integration such as teacher time issues, access, support issues (administrative, technical and financial), planning, the knowledge level and the confidence level of teachers. Clearly, technology implementation is a challenging task. Teachers need support if it is to become a reality. Further studies are recommended in the different parts of the country to determine how others within education view the integration of computer technology in mathematics classrooms.

Dedication

This work is dedicated to the memory of my father, Yousif Khalil Arouni, whose example in life taught me the true meaning of honesty, patience and perseverance. He will be missed.

Researcher's Acknowledgments

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TABLE OF CONTENTS

A Survey of Teachers' Attitude towards Integrating Computer Technology and Their Beliefs Regarding its Impact on Their Effectiveness in the Classroom

CHAPTER ONE

Technology is rapidly invading today's modern society and becoming widely available in schools. Recognizing the growing role of technology in everyday life represents a serious challenge for teachers and an opportunity for researchers to better understand how technology shapes, and is shaped by, beliefs about teaching and learning.

Society evolved from the Greek's idea of a sound mind in a sound body to the European inquiry-oriented traditions of Coenius, Pestalozzi and Montessori to the present, educators have called for teaching and learning that integrate disciplines and fields (Tchudi & Lafer, 1996). With this evolution, teachers have to acquire a discipline and need to seek learning rather than wait for inspiration. This has stressed the need to provide teachers with skills to meet the technologically advancing society.

With each passing year, technology is occupying a larger part of our daily lives. As education changes to reflect new social and educational needs, teaching strategies also change. Consequently, new teaching strategies are adapted to integrate computer technology into teaching/learning situations. According to Goldenberg (1998), a coherent vision is required to develop an approach to using technology in the teaching of mathematics that evolves consistently as the technology changes. Today, educators' appreciation of the role of technology depends on their perceptions of the goals of education and appropriate instructional methods to help students accomplish these goals. Soloman (1995) expressed this relation by claiming, "It's the vision thing... that is, we first have to ask 'What do we need

technology for?' And on that basis, we must create our vision, define the aims and objectives for technology usage in our departments, then plan for its use" (p.66).

Borko and Putnam (1995) assert that teachers' knowledge and beliefs play an essential role in their practices and shape the learning that goes on inside and outside their classroom. Teachers' new knowledge basis shapes their perception about how to work on improving their teaching by building a wider repertoire of what educational change means. In order for teachers to adopt educational innovations, such as technology, they need to "think in new ways about students, subject matter, and the teaching-learning process" (Borko & Putnam, 1995, p. 38).

Yet, one should remember that technology brings with it a new set of complexities and uncertainties that cause teachers to feel vulnerable and threatened, and consequently resist change unless they have opportunities to engage in long-term, sustainable teacher training programs or supportive team involvement.

Sustainable teacher training involves a change in the way teachers think, talk, and act in their classrooms. This may take the form of creating a supportive environment for teachers that allows them to ask the important questions, hold discussions and share their experiences with different practitioners. It also involves teachers implementing technology use in their classrooms, using them as laboratories to test whether or not what they have learned about technology is feasible.

Statement of the Problem

It was noted that, in the Lebanese context, there is no research about teachers' attitudes towards integrating computer technology, or on their beliefs regarding the impact of integrating computer technology on Middle School teachers' effectiveness in the classroom.

Since it is ascertained in the beginning that we are living in a technologically advancing world, it is imperative to study the impact of this advancement on teachers' beliefs and practices (Borko & Putnam, 1995). This study aims to show that technology has an effect on the ideas and practices of teachers. It is hoped that the results of this study may be a stepping stone for Lebanese teachers and administrators to guide and monitor their efforts in the area of technology.

Purpose of the study

The purpose of this study is to investigate Middle School Mathematics teachers' attitudes towards integrating computer technology, and their beliefs regarding the impact of integrating computer technology on their effectiveness in the classroom.

Research Questions

This study attempts to answer the following research questions: (1) Is there a significant difference between attitudes of teachers who actually use computer technology and those who do not?, and (2) how do teachers perceive the impact of using computer technology on the following: (a) the type of mathematical content they teach, (b) their pedagogical skills, and (c) their ability to adapt the curriculum to the needs of their students.

Hypothesis

The study will test the following hypotheses: (1) There is a significant difference between attitudes of middle school mathematics teachers who actually use computer technology and those who do not towards integrating computer technology, and (2) there is a significant difference between beliefs of middle school mathematics teachers who actually

use computer technology and those who do not, regarding the impact of integrating computer technology on their effectiveness in the classroom.

Null hypothesis

There is no significant difference between attitudes of middle school mathematics teachers who actually use computer technology and those who do not towards integrating computer technology, and there is no significant difference between beliefs of middle school mathematics teachers who actually use computer technology and those who do not, regarding the impact of integrating computer technology on their effectiveness in the classroom.

Rationale for the hypothesis

Debates in literature show opposing views about the expanding role and influence of computer technology. Some teachers in the field question and even contest the effectiveness of technology as an aid to teaching and learning, and thus are not willing to advocate the use of technology in the classroom. In contrast, some others adopt the view that technology is here to stay and it should be included as a part of mathematics classrooms, if instruction is to be relevant to students' daily lives. One of the factors affecting the implementation of educational change in general, as seen by Fullan (1982), is the teachers' perception of the efficacy of the change per se. For this, Cortazzi (1993) quoted the claim by Louden (1991) that the teacher is the ultimate key to educational change and school improvement. "Teachers don't merely deliver the curriculum. They develop it, define it and reinterpret it too. In other words, it is what teachers think, what teachers believe and what teachers do at the level of the classroom that ultimately shapes the kind of learning that young people get" (p. vi.).

In order to foster a better understanding of how teachers use or might use computer technology in the classroom, it is essential to explore the relationship between their attitudes

towards the use of computer technology and its integration in the classroom. Kluever, Lam, Hoffman, Green, and Swearingen (1994) assert that measuring teachers' attitudes towards computers is still important due to the low level of computer use in schools.

Independent Variable

Computer technology integration in mathematics classes.

Operational Definition of the independent variable

By "Integrating computer technology in mathematics classes" we mean using mathematics software (Logo, Cabri, Geometry Sketchpad, Mathematica, Derive, etc.) in various forms and activities such as: explaining new material, conducting learning activities, discovering and exploring relationships or patterns, and modeling real-life examples.

Dependent Variables

Teachers' attitudes towards integrating computer technology, and teachers' beliefs regarding the impact of integrating computer technology on their effectiveness in the classroom which are portrayed in three domains: (a) the type of mathematical content they teach, (b) development of their pedagogical skills, and (c) adapting teaching and curriculum to students' needs.

Operational Definition of the dependent variables

Teachers' attitudes and beliefs can be detected in different ways. The study will focus on how teachers' attitudes are reflected by their willingness to be involved in new learning experiences involving the use of technology. These experiences would lead to altering the

type of mathematical content they teach, modifying their pedagogical approaches, and changing the curriculum to adapt it to the needs of their students.

Significance of the study

It can be seen that this study is significant for it sheds light on the way teachers think about, and deal with the integration of technology in their classrooms, and allows them to examine their own knowledge and beliefs about teaching and learning. It will contribute to the entire school body for it will give schools new spectra and visions catered for education in the 21st century and it will, as well, encourage schools and teachers to adopt more positive attitudes. Moreover, it will open new horizons for further research that will continue along the same line and try to verify the results obtained in this research by conducting similar researches in the different parts of the country.

A brief overview of the thesis and its contents

In chapter two, the literature review summarizes the integration of computer technology in Mathematics classes and the conditions surrounding it in schools, and on teachers' beliefs and attitudes toward this integration. Chapter three is the research design and methodology section. The method adopted to obtain information from mathematics teachers is the attitude survey using a questionnaire complemented by structured interviews. In Chapter four, an analysis is constructed and the results of the data collected –questionnaires and interviews– as well as a discussion of these data are presented. Finally, Chapter five contains relevant conclusions and recommendations. Moreover, expected results of the study as well as results that were unexpected are described and related back to the literature review.

CHAPTER TWO

Literature Review

Computers are powerful tools that, like many other technologies, are most beneficial when used as a natural part of the learning experience. This includes the following: (a) Integrating computers into the classroom environment, (b) using them as a part of the ongoing curriculum, and (c) applying their use to real problems for a real purpose (Davis & Shade, 1994).

They are environments through which problem solving may take place. The graphical and computing possibilities of some software now allow reification of abstract objects and in particular of mathematical objects. They also allow for numerous possible operations on these objects along with various forms of feedback. In addition to providing dynamic classroom demonstrations of traditional topics, computers as function and relation graphers seem to offer opportunities for significant changes in the content and processes of school mathematics.

With the advent of computer teaching and learning environments, new roles emerge for teachers and students alike. As a result, the computer is no more a set of tools which define allowed actions such as sharing and re-negotiating mathematical expression and facilitating the construction of mathematical meanings only. Rather, the computer opens new windows onto more general, systematic appreciation of the ways mathematical meanings are constructed in the broader educational culture, at the ways in which the educational system comes to construct meanings for school mathematics (McLeod, 1992).

The computer points to possibilities. It sets us thinking about ways of representing mathematics as a cultural practice, not merely a schoolish activity to achieve technological know-how for the few to pass tests, but to educate in the broadest sense.

The role of mathematics in underpinning social and economic life stretches back to the dawn of the industrial revolution and beyond (Noss & Hoyles, 1996). Every aspect of modern society is infused with the complex mathematical labor of mathematicians, computer scientists, and engineers and so on. "Yet, at the same time, this mathematics is increasingly visible to those who merely share in, rather than construct, the artifacts of the culture. It is mathematics, which lies dormant inside the chips of vacuum cleaners, the warheads of missiles and the graphical displays of news broadcasts" (Noss & Hoyles, 1996, p.48).

With a flashback, starting in the late 1970's, studies were compiled in order to provide more information on the overall effect of technology use in mathematics classrooms. In the 1970's and 1980's most of the studies on calculator use, conducted in the US, were at the elementary level (K-6) with a few studies on calculator and computer use in the secondary level (7-12) (Hembree & Dessart, 1986; Suydam, 1976; Suydam, 1980). Hembree and Dessart (1986) combined the information from Suydam and other studies comparing computer-based instruction to other types of instruction and found that the overall achievement for most grade levels was significantly and positively affected by the use of calculators and computers for computation and problem-solving. King (1997) also compiled studies that investigated the effect of computer-enhanced instruction on student achievement. Technology use included teacher demonstration using a single computer. King's research found statistically significant positive effect on overall achievement.

The coincidence of the economic boom of the 80's with the mushrooming of cheap, available and powerful computational technologies allowed the rise of change (Smith, 1996).

More than a century ago, Marx famously observed that even the most advanced machines of his day required the application of human labor power to produce wealth. Now, it appears, some are becoming tacitly to recognize the truth of Marx's observation. As the twentieth century was drawing to a close, it was becoming more evident that intellectual (rather than merely physical) human resources are required to breathe life into technology in order to release its potential. The computer permits us to make visible all mathematical structures and relationships, which are hidden beneath the surface of our realities. It is ironic that the computer is a means: Perhaps the only means to realize this possibility (Papert, 1996). The computer allows us to construct settings which synthesize meanings across the cultural divide between application and understanding.

As such, we see that the major influence of technology on mathematics education is its potential to shift the focus of instruction from an emphasis on skills to an emphasis on developing concepts, relationships, structures, and problem solving skills. According to Laborde (1998), the technology should not be used for itself, but for supporting, improving and changing the learning of mathematics through explorations of a great number of cases, possible variations of the problems, and visual or numerical feedback. Clements (2000) believes that the purpose of using technology is not to make the learning of mathematics easier, but richer and better. The focus when using technology should not be on what the tool does, but on the way children think. Despite the palpable importance of hardware, content and pedagogy of the software should receive more emphasis.

In this sense, Van de Walle (1998) outlines three ways technology is changing the nature of mathematics education. First, some mathematics skills have decreased in importance. Time taken to perform tedious paper and pencil computations or graphical representations can be put to better use in more reasoning and interpretation-oriented endeavors. This approach

mirrors ways technology is used in everyday life. Second, the pedagogical idea that mathematics can be taught more effectively using computers. For example, visual and contextual representations that might not otherwise be available, can be included, and teachers can use computer-based simulations to provide students with opportunities to work on problem situations that are difficult to experience without technology. Third, some mathematics topics and skills are more accessible or can receive greater emphasis. Data analysis is a prime example.

The use of calculators and computers as standard tools in quantitative problem solving situations, however, has diminished the value of human proficiency in the execution of such procedures (Owens, 1998). As such, Calculators and computers need to be viewed as cooperating technologies, rather than competing technologies (Kaput, 1998). For example, suppose a teacher has a computer available in the classroom and wants to use it to teach mathematics, how does he/she go about developing a lesson? A lesson that exploits the use of technology enables students to participate in constructing their knowledge. Students might be involved in running experiments, testing conjectures, solving and posing problems and exchanging ideas. During the activity, questions should direct students to analyze and synthesize their observations (Burton, 1999). The atmosphere should encourage communication among students – questioning, suggesting, challenging, listening, and striving to develop convincing arguments for beliefs and conjectures. However, even if a teacher were to have access to a variety of hardware and a library of software, searching through all the available applications to find appropriate materials would be overwhelming, time consuming, confusing, and ineffective.

Wilson (2001) provides some guidelines for teachers who are limited by the software and equipment available. In such a case, a more productive method is needed. This method is

to start with a particular example of technology, learn how to use it, analyze what it does, determine how it might be used to teach mathematics, select certain topics that would benefit from this approach, and then develop lessons.

This method seems to work well whether the technological aid is a calculator or a piece of software. The object is not merely to use the technology but to exploit it. That is, to make the technology work to give the teachers and students access to mathematical concepts.

Technology and the curriculum

Computers are used advantageously across the whole curriculum in some schools but the link with mathematics has always been a very close and special one. The fundamental connection between mathematics and information technology is important. It is a fact that the mathematics that satisfies society's needs changes and the mathematics, which is accessible to our students, becomes naturally different.

Everybody Counts (NRC, 1989) called the Americans' attention to the fact that curriculum and instruction in their schools and colleges are years behind the times; they reflect neither increased demand for higher thinking skills, nor greatly expanded uses of mathematical sciences, nor what we know about the best ways for students to learn mathematics. In other words, with each passing year, technology is becoming more a part of our daily lives and as education changes to reflect new social and educational needs, teaching strategies must also change. Consequently, new teaching strategies were adapted since then, to integrate computer technology into teaching/learning situations. Teachers reported that they did not see technology as relevant to the mathematics curriculum they taught; moreover, they believe that while technology might be nice, it could not impact the curriculum (Manouchehri, 1999). Today, educators' appreciation of the role of technology depends on

their perceptions of the goals of education and on their awareness of appropriate instructional methods to help students accomplish these goals. Soloman (1995) expressed this relation by claiming, "It's the vision thing... that is, we first have to ask what do we need technology for? And on this basis, we must create our vision; define the aims and objectives for technology usage in our departments, then plan for its use" (P.66).

The National Council of Teachers of Mathematics (NCTM, 1989) contends that when a curriculum is implemented, time and emphasis must be given to the use of technology to teach mathematics concepts, skills, and applications in the ways they are encountered in an age of ever increasing access to more powerful technology. As the view of learning mathematics changes, so must practices of teaching mathematics change (NCTM, 1989; NRC, 1989). Everybody is talking about technology integration, but few practicing teachers profess to know exactly how to proceed. "The fact is that real integration requires change. . . . However, what seems to be lacking is a model that teachers can use to guide them through the necessary changes they will need to make to be successful in integrating new technology into their classroom" (Johnson & Liu, 2000, p. 4). Thus it is necessary to understand the process involved as teachers make changes in their previous ways of teaching mathematics to accommodate the transformation advocated.

Cuoco and Goldenberg (1996) describe mathematics as not just a collection of knowledge and results but also a collection of methods, ways of thinking and habits of mind. As a consequence, changes in school mathematics can occur only if teachers are recognized as key figures in the reform process. Bottino and Furinghetti (1994) affirm that the change in teaching practices using technology is unlike other curriculum changes in mathematics, this change does not come from within the mathematics community as a consequence of certain cultural developments of the discipline, but as the consequence of the great changes in the social and economic reality provoked by the impact of new information technologies. Cooney

(1990) provides a perspective in which success of the current reform effort is seen as contingent upon teachers' abilities to shape classroom events and to create learning environments compatible with the present state of knowledge of the learning and teaching of mathematics. Because so many current teachers of school mathematics are themselves products of the "transition of knowledge" perspective, there is no need to bring to effect what Richardson (1990) has called "significant and worthwhile change" in mathematics teaching. Facilitating meaningful change in instruction will entail helping teachers rethink and learn new mathematics content and stances towards teaching and learning (Coff & Steffe, 1983; Cobb, Wood and Yackel, 1990; Noddings, 1985; Putnam, 1992; Heaton, 1992; Prawat, 1992b; Remillard, 1992). Moreover, Pierson (2001) argued that educational reform efforts should not only focus on acquiring more machines for classrooms but also on developing teaching strategies that complement technology use within the curriculum. Any attempt to improve the quality of mathematics teaching must begin with an understanding of the conceptions held by teachers and the way these are related to the instructional practice.

Therefore, in order to bring desirable changes to the system, we need to find out what is actually happening when teachers undertake changes in their teaching practice.

Technology and teachers

Teachers' attitudes.

While the above studies show the significance of new technologies in teaching, it was an imperative issue for researchers to consider teachers' attitudes towards the use of computer technology. Positive teacher attitudes toward computers are widely recognized as a necessary condition for effective use of information technology in the classroom (Woodrow, 1992).

Battista (1999) wonders "how would one react if a doctor treated his/her children with methods that were 10 to 15 years out of date, ignored current scientific findings about diseases and medical treatments, and contradicted all professional recommendations for practice? It is highly unlikely that one would passively ignore such practice" (p. 425). Yet this is exactly what happens with traditional mathematics teaching, which is still the norm in most schools. Teachers, as with any profession, need opportunities to expand their knowledge, keep pace with developments in their field, try out new methods, exchange ideas with peers and experts, refine and upgrade their skills in order to further their effectiveness. According to many studies, the attitudes of teachers are basically due to the lack of knowledge, lack of confidence, training and support, disregard of science, time constraints, access and testing.

Lack of knowledge. The major impediment to improving students' mathematics learning is teachers' lack of knowledge. Teachers' knowledge about technology affects their perception of integration which in turn affects their decision to use it. Teacher awareness is highly correlated with teacher attitude about technology. In other words, teachers who have higher awareness of technology tend to have better attitudes toward using technology (Coffland, 2000). Because few adults have a genuine understanding of mathematics or of the mathematical enterprise, mathematics has been taught poorly for too long. Most adults believe that mathematics is the performance of a set of procedures invented by others. Due to the abundance of technical terminology, many teachers feel that they lack the skills necessary to successfully implement computers. According to Zammit (1992), such lack of confidence regarding computer use is one of the most important factors hindering teachers' use of computer technology in their teaching. Consistent with Zammit, Dalton (1989) notes that many teachers viewed learning the skills necessary to operate a computer as too complex, requiring too much effort to master, regardless of the benefits the computer may provide.

Although technology offers the potential to enhance and improve the students' learning experience, there is a lack of consensus on how to combine computers with other learning tools. This absence of agreement causes too many teachers to be casual or even non-users of computers (Woodbridge, 2003). Battista (1999) argues that, "they have learned -and expected others to learn- mathematics as a set of rigid rules invented by others. They simply do not understand mathematics well enough, to appreciate when it has been learned well" (p. 430). Teachers who grew up learning mathematics in the traditional methods tend to question the role of technology and feel insecure in the integrated form of teaching (Hazzan, 2000). However, Slough and Chamblee (2000) also report that teachers who have positive experience in using technology to help their work tend to teach their students with technology.

Lack of confidence. The experience in both learning with technology and teaching with technology greatly affects the teacher's confidence on integrating technology in math lessons. Confidence is highly related to technology use (Molebash & Milman, 2000). It is obvious then, that teachers' past experience in using technology affects their beliefs about themselves as effective teachers.

Training and support. Many papers recommend training in order to increase the use of technology by teachers (Matthews, Davis, and Hamilton, 1996). Ertmer and Hruskocy (1999) found that with a well-planned training and support program, teachers increased the uses of technology for professional tasks such as record keeping, creating instructional materials. Consistent with Ertmer and Hruskocy, Gilmore(1995) believes that a systematic training program increases teacher confidence and actual use of technology. However, the lack of training at pre-service stage (Wetzel, Zambo, and Buss, 1996) and the lack of in-service

In a study on teachers' attitudes towards computers in education, teachers viewed educational computing as an "add-on" to the existing curriculum and as a burden to be "squeezed into" the already loaded schedule of instruction (Dalton, 1989; Wiley, 1992). Weber (1996) found that the school environment and curriculum requirements sometimes discourage integration of technology because teachers have no enough time to accommodate for the heavy workload. The more classes a teacher teaches, the less likely he or she will integrate technology in the lessons.

Putting scientific research aside, most teachers have plenty of personal experience that contradicts the issue of time constraints. How many times, may be several weeks after teaching a topic, do teachers return to the topic and find their students acting as if they have never seen it before? How many times at one grade level do teachers find themselves facing students who are totally ignorant of mathematical topics already covered during the previous year –even claiming that they had never seen the topics before?

Access. One of the obstacles is access problem. Access problems include limited equipment (Hadley & Sheingold, 1993; Ringstaff & Yocam, 1994), lack of access to educational software (Manouchehri, 1999), and difficulties in scheduling the computer lab to fit curriculum (Wetzel, Zambo, and Buss,1996).

Testing. Most schools rely on standardized tests and government exams as bottom-line measures of their students' performance. This practice has several consequences. If the tests measure traditional outcomes, their use maintains the inaction of traditional instruction and seriously impedes the introduction of an innovation such as the integration of technology. Consequently teachers who feel time pressured would like to take a safer measure that leads to better preparation for government tests.

Moreover, poor understanding of the concept of testing creates the "teach to the test" phenomenon that is observed in many school systems. Systematically, as Wilson (1998) states it, "this reduces the mathematics curriculum to mimicry" (p. 61).

Teachers normally adopt certain attitudes in their classrooms to better convey the message to the students. If they can clearly see that the integration of technology will facilitate the way students understand, that should be an added incentive to encourage them to change their attitudes about its effectiveness.

Teachers' beliefs.

Teachers' attitudes, beliefs, and practices are interrelated. Cuban (1993) reports that the acceptance or success of computers in the classroom is based on the belief systems of the teachers who are actually responsible for integrating technology. Richardson (1990) argues that teachers' attitudes and beliefs about themselves as teachers and learners shape their actions. Pajares (1992) asserts that the investigation of teachers' beliefs "should be a focus of educational research and can inform educational practice in ways that prevailing research agendas have not and can not" (p. 307). Kagan (1992) affirms that the study of beliefs is critical to educational practice. She argues that beliefs may be "the clearest measure of a teacher's professional growth "and that understanding them is "instrumental in determining the quality of interaction one finds among teachers in a given school" (p.85). Ernest (1988) emphasizes the importance of mathematics teachers' beliefs by claiming that teachers' approaches to mathematics teaching depend basically on their systems of beliefs; in particular on their conceptions of the nature of mathematics, and on their mental models of teaching and learning mathematics.

It also appears that teachers can unknowingly pass negative views on to their students through the "hidden curriculum". The way computers are used is also important. Teachers who allow students to only use drill and practice software are not conveying to their students the value of problem-solving technology. Students may regard computers as another game to play when "finished with their work". In this sense, sustainable teacher training which involves a change in the way teachers think, talk, and act in their classrooms is essential. To help students understand mathematics conceptually, mathematics teachers need to develop various strategies to make mathematics concepts visual, live, connected, and meaningful (An, Wu, and Kulm, 2004). This may take the form of creating a supportive environment for teachers to ask the important questions, hold discussions and share their experiences with different practitioners. Pierson (1999) believes that "experienced teachers need time for reflection and collaboration with other teachers so that they can envision technology use in relation to their established practices in multiple contexts" (p. 28).

Numerous studies have revealed that teachers' confidence is related to their beliefs and their knowledge (Campbell & White, 1997). So, teachers need substantial, ongoing preparation in technology use with sufficient time to explore, and convenient access to computers in order to gain the confidence and competence necessary to teach students to use it effectively. The Educational Testing Service (1997) states that: "School leaders report that the learning curve is steeper for teachers than it is for children, and many have told us that the biggest mistake they made when introducing computers and other technologies into their classrooms was underestimating the amount of training the teachers would need" (p.8). Teachers need to use their wisdom in deciding when to use technology and when other approaches are more convenient. Teachers also need the additional support of trained personnel to help them plan, maintain and coordinate the use of technology. Planning the use of computers in the classroom is important. Professional Development of teachers in

technology has been linked to student achievement and same aspects of school climate (Educational Testing Service, 1997). Therefore, strong efforts must be made to ensure continuous, quality teacher education in use of technology, at both pre-service and in-service levels. Members of the Association of Mathematics Teacher Education recently debated the need for specific "technology in mathematics education" courses in teacher education programs. Proponents note that such technology use might not be sufficiently addressed otherwise (e.g., in methods classes), due mainly to time constraints and insufficient specialized knowledge on the part of the instructor.

Goldenberg (1998) notes that: "Computers are nothing but what they're used for, and what they're used for changes constantly...The teachers remain constant novices" (p.1). The Educational Testing Service (1997) recommends that schools reserve one-third of their technology budget for teacher preparation. If reform in learning mathematics is to be successful, attention must be given to existing practices of mathematics teachers.

Although a constructivist view of learning mathematics has been commonly accepted by researchers and mathematics teacher-educators alike (NCTM, 1989; NRC, 1989), learning mathematics in school still continues to be dominated by the traditional "transmission of knowledge" view. Failure to recognize the role that teachers' beliefs might play in shaping their behavior is likely to result in misguided efforts to improve the quality of mathematics instruction in schools (Glasersfeld, 1988).

Computer training is needed because most teachers have a conception of mathematics as a static body of knowledge, involving a set of rules and procedures that are applied to yield one right answer. "Knowing mathematics means being skillful and efficient in performing procedures and manipulating symbols without necessarily understanding what they represent" (Thompson, 1992, p. 130). These beliefs about mathematics confer upon teachers the

responsibility of transmitting those rules. Consistent with this conception of mathematics and mathematics learning, the teacher is in control. The main goal for teachers should be acquiring new knowledge and skills that empower their ability of effective teaching in this ever changing and developing digital era (An, 2004) and engaging in creating and designing instruction using technology (NCTM, 2000).

Research on prevalent practices finds that in a typical lesson, the teacher reviews or introduces a new procedure, provides students with step by step instructions, then assigns students problems on which to practice the procedure (Stigler & Hiebert, 1997; Wood, Cobb, and Yackel, 1991).

Inquiry-oriented mathematics educators take a more dynamic view of mathematics, conceptualizing it as a discipline that is continually undergoing changes and revision (Prawat, 1992a). They embrace a conception of mathematics as a tool for problem solving and a set of cultural understanding that arises out of problem-solving activity (NCTM, 1991; Thompson, 1992). Accordingly they recommend classroom practices that actively engage students in activities that will assist them in constructing mathematical concepts, activities that require reasoning and creativity, gathering and applying information, discovering and communicating ideas (Ball, 1993; Cobb, Wood, Yackel, and McNeal, 1992; Lampert, 1991; Thompson, 1992; Wood, Cobb, and Yackel, 1991). Thus, the role of the teacher is to support and guide this constructive process rather than to transmit discrete knowledge. Teachers must have opportunities to engage in long-term, sustainable teacher training or team involvement so as not to feel vulnerable or threatened. It is imperative that teachers be equipped with the knowledge and skills required to successfully integrate technology into the curriculum.

It is no longer acceptable to view computers simply as a word processor, or drill and skill machines. Teachers, along with their students, will see the computer as a limitless source

of information waiting to be tapped. Since control is now being shifted to the local level, teachers will be able to use these new resources to create a more conducive learning environment for their students. According to Mandelbrot (1994), computers are responsible for a "rebirth of experimental mathematics". They provide educators with wonderful tools for generating and validating patterns that can help children learn to reason mathematically and master basic skills. Moreover, teachers will also be able to transform classroom environments in ways that will more adequately match real life environments (Jaworski, 2001).

In this respect, it is important to note that the classroom teacher's philosophy of mathematics education, and its implementation, ultimately shapes classroom learning.

Technology and students

Changes in favor of greater use of computers in mathematics teaching align nicely with other methodological emphasis presently espoused by experts in the field, most notably, students' responsibility for their own learning (Heid, 1997). Students become more autonomous, teachers more facilitative, and learning more authentic during carefully designed computer-based projects. This student-centered environment also lends itself, contrary to the popular belief about computer use, to collaborative group work. Students can pursue mathematics-oriented goals in dyads at the computer, or they can work independently and then share the results of their work with other students (Heid, 1997).

Piagetian theory contends that children construct knowledge through interactions with people and materials. The goal is to encourage children to become actively involved with the world around them. Although computer games are being blamed for socially isolating children in non-reactive situations, where the students may become visually engaged, often

without meaningful interactions. Unfortunately, many parents and teachers still equate educational computer programs with these video games. However, Papert (as cited in Davidson & Wright, 1994) argues that this same holding power can be used to draw children into rich learning environments.

Computer use can be a social activity, inviting cooperation and collaboration. Exploration, experimentation, and problem-solving skills can be included in an environment where unexpected learning opportunities can occur. According to the International Society for Technology in Education (ISTE, 2002), within a sound educational setting, technology can enable students to become problem solvers and decision maker. "The teacher is responsible for establishing the classroom environment and preparing the learning opportunities that facilitate students' use of technology to learn, communicate, and develop knowledge products" (ISTE, 2002, p.4).

In a technology-based curriculum, students learn how to interrelate ideas, and tend to retain them longer, whereas students in traditional curricula learn ideas and procedures in a fragmented way. Consequently, reteaching is drawn to a minimum.

Integrating computers into the curriculum offers students the opportunity to interact with an educational tool that is much a part of the present culture. As Cradler (1992) says technology is a tool that when used with tested instructional practices and curriculum can be an effective catalyst for education reform.

Effective integration of technology

Pierson (1999) defined technology integration as teachers utilizing content and technological and pedagogical expertise effectively for the benefit of students' learning. As with any educational intervention, the effectiveness of technology depends upon the

technology can enable students to interact with people and materials from many different cultures.

However, computers are worthless if no quality software is available. When schools update their hardware, they sometimes fail to consider corresponding software. The problem is then compounded by the abundance of software that does not go beyond drill. "The effectiveness of computer learning depends critically on the quality of the software, the amount of time children work with the software, and the way in which they use it. Not surprisingly, studies indicate that CAI can be effective only if teachers consider such critical features" (Clements, 1994, p. 33).

Integration of technology in the teaching of mathematics is not limited to the use of mathematical software. Other generic software can also be used, such as spreadsheets and graphic organizers. Literature shows that graphic organizers are one example of a group of tools that can be used across content areas. Databases, word processors and hypermedia software are other examples of this group. Literature also shows that spreadsheets provide opportunity for students to work with real, authentic problems. It is possible for students to gain a variety of experiences while using this approach. They can learn to use the spreadsheet, then create graphs and interpret data displayed on spreadsheets. Working with the "what if?" questions that are inherent in the use of spreadsheets helps students use their knowledge of the problem and prior knowledge of similar situations and content meaningfully (Handler, Dana, and Moore 1995).

There are many examples of software, but it is important to remember that each classroom has different needs based on the students in that classroom. It is up to the teacher to look for reviews of software and to find ways in which to evaluate the software in light of

the goals for the particular lesson and setting, and then set up the environment and activities, matching technology use to the curriculum as well as to the students' needs and interests.

The above literature shows the importance of integrating computer technology in mathematical classrooms, of the teachers' beliefs and attitudes towards its use and the conditions surrounding it in schools. However, the review of literature shows a lack of information about studies done in Lebanon that investigate teachers' attitudes about technology use in mathematics classrooms, and the factors behind these attitudes. Thus, the need for such a study arises.

CHAPTER THREE

Research Design and Methodology

The method adopted in this study for obtaining information from mathematics teachers is the attitude survey using a questionnaire. The information obtained is to be used to determine the teachers' beliefs whether integrating computer technology in their teaching improves their effectiveness in the classroom, and their attitudes concerning such integration.

In support to the results of the survey, and in order to have a deeper insight in teachers' attitudes and beliefs, structured interviews are conducted with a random sample of eight teachers chosen from the responding population

Subjects and Sample Selection

The sampling technique is the cluster sampling. Burns (2000) defines this kind of sampling as "sampling of entire natural groups rather than individuals". He adds, "it retains the principle of randomness and allows a research design within the scope of the individual researcher. This kind of sampling is of benefit to the researcher if the population is spread widely across a large geographic area" (Burns, 2000, p.90). The population in this study consists of teachers from public and private schools in Sidon and Beirut areas. Nine schools and 11 schools are selected in Beirut and Sidon respectively. Seven schools are public and 13 are private schools. Table 1 shows the distribution of the selected schools according to their type and geographic area.

Table 1

Number of schools in each category

Categories of Schools	City	
	Beirut	Saida
Public	3	4
Private	6	7

The criteria for the selection of teachers to form the sample are:

1. The teacher must be a mathematics teacher in a school in Beirut or Sidon area.
2. The teacher must be teaching at a private or a public school at the intermediate grade level.

The questionnaire was sent to 150 teachers who met the above criteria, of which only 100 accepted to respond. These 100 teachers formed the group to be studied.

With respect to interviews, a random sample of eight teachers was selected from the 100 responding teachers. Two teachers were randomly chosen from public and two from private schools in Saida city, and the other four teachers were chosen in the same way but from schools in Beirut city.

Instruments

The questionnaire.

A questionnaire was designed by the researcher. The questionnaire consists of five pages. Page one acts as a cover page that includes four different items:

1. A briefing about the research being conducted.
2. The way to return the questionnaire to the researcher.
3. A consent form informing the participants of their rights.
4. The name and e-mail to contact the researcher if there were any questions or concerns about the research being administered. (See Appendix A for the complete questionnaire).

Pages two, three, four and five consist of nominal questions that mainly focus on the subjects' demographic information as a teacher, and ordinal questions dealing mainly with teachers' attitudes towards integrating computer technology, and with their beliefs regarding the impact of integrating computer technology on Middle School teachers' effectiveness in the classroom. The majority of the questions of the questionnaire use a five-point Likert scale measuring system, a measurement method invented by Renis Likert in 1932. The Likert scale in this study asks the teachers to choose one of the following responses for each statement:

1. Strongly disagree
2. Disagree
3. Undecided
4. Agree
5. Strongly Agree

The Likert scale allows for a wide range of attitudes and opinions. According to Burns (2000, p.560), "The advantages of the Likert method include: (a) greater ease of preparation, (b) the fact that the method is based entirely on empirical data regarding subjects' responses rather than subjective opinions of judges, and (c) the fact that this method produces more homogeneous scales and increases the probability that a unitary attitude is being measured, and therefore that validity (construct and concurrent) and reliability are reasonably high".

Information and instructions were provided to the respondents about how the Likert scale works and how to use the Likert scale. The questionnaire also has an open-ended section where the information provided by the teachers can be elaborated and they can add their own comments or feedback.

Piloting the questionnaire.

Prior to the administration of the questionnaire, it was piloted through administering it to ten teachers having the same characteristics as the sample. The results of the piloting were used to (a) modify some items of the questionnaire which were not well understood and were interpreted differently by the teachers and (b) add some other items related to teachers' beliefs regarding computers and students with special needs, which were considered essential for the study.

The interviews.

The questionnaire was also complemented by a set of structured interviews with a random sample of eight teachers chosen from the responding population. The interviews consisted of five questions raised in an identical way to each of the eight teachers. The aim of these interviews with their detailed questions was to develop a deeper insight about teachers' attitudes. One of the reasons for conducting those interviews is that many teachers did not respond to the open-ended section in the questionnaire to write their own comments.

Data Collection

The researcher placed a questionnaire along with a return address in each teacher's mail box in the selected schools. The participants in this study were given one month to complete the questionnaire. Upon completion, the questionnaire was either personally handed to the

researcher or to an administrator in school who passed the questionnaires to the researcher. After 3 months, the researcher sent thank you letters to all participants for taking part in the study (See Appendix B).

Afterward, eight teachers were chosen from the responding population to be interviewed. The interviews were audio taped, and interview notes were taken. Teachers' responses in the interviews were analyzed in details, and inferences were made to further support the results of the questionnaire.

Data Analysis

The questionnaire.

The data collected from the subjects in this study were statistically analyzed by the researcher using a computer program MegaStat(C) (Oriss, 2001). Nominal questions were coded using numbers to identify the four categories which are gender, level of education, years of experience, and grade level taught. For example, for the question dealing with gender, female was coded (1) and male was coded (2). Mathematics teachers' responses were tabulated for frequencies, percentages and cross tabulations from the questions on the survey. The responses for the Likert scale questions were ordinal responses that do not allow numerical calculation. In order to solve the problem and facilitate calculations, numerical values were assigned for the responses of each question.

Ordinal questions were measured the following way:

Response	Value
Strongly disagree	1
Disagree	2
Undecided	0
Agree	4
Strongly Agree	5

Thus, the responses had a range between zero and five. The values of items indicating negative attitudes or beliefs were reversed. For example, if item 13 which says "Computer technology intimidates and threatens me" was given the value 1 or 2, then these values will be reversed to 5 or 4 respectively. The teachers' responses were used to answer the two research questions:

1. Is there a significant difference between attitudes of teachers who use computer technology and those who do not? (Items1 till 21 in the questionnaire)
2. How do teachers perceive the impact of using computer technology on the following aspects: (a) The mathematical content they teach (Items 22 till 32 in the questionnaire), (b) their pedagogical skills (Items 33 till 45 in the questionnaire), and (c) their ability to better adapt the curriculum to their students' needs (Items 46 till 59 in the questionnaire).

For this purpose, ANOVA and T-tests were used.

The interviews.

The interviews are made up of five questions representing an in-depth analysis of teachers' attitudes towards computers (See appendix C for these questions). The process of qualitative data analysis involves taking the data apart and then reconstructing it to identify

what is to be learned and the patterns that might exist within the data. Beginning categories for analysis were generated from the research questions, and evaluated for fit as the data were analyzed.

The data coding was organized to define patterns in the transcriptions of the interviews. This process involved reading transcriptions to get a sense of the whole, identifying codes, and grouping categories of data together according to the codes. Codes should relate to one another in coherent, study-important ways and provide a governing structure for the analysis (Miles & Huberman, 1994). Two main coding categories were formed as well as subcategories. One of these two categories is about the teachers' attitudes towards technology integration and the factors behind these attitudes, such as issues of time, access, planning, knowledge level, confidence level, and support (administrative, financial and technical). The second category is about the teachers' beliefs regarding the impact of the integration of technology on the type of mathematical content they teach, their pedagogical skills, and their ability to adapt the curriculum to their students' needs. The coded categories and subcategories were built-in a table (See Appendix D). Appendix D provides a list of the coded categories and subcategories, as well as a sample of teachers' responses in the interviews, classified under these categories. The data collected in these interviews contributed to a deeper understanding of the teachers' attitudes and beliefs, provided elements for interpreting the results and helped the researcher better evaluate the original hypothesis.

Limitations

Several limitations have been identified by the researcher. They are made explicit in the following:

1. The sample of teachers is limited to Mathematics Middle School teachers in only two cities in Lebanon, Saida & Beirut.

2. The questionnaire is developed by the researcher (it is not a ready-made attitude test), no validity or reliability tests are conducted but internal reliability using Cronbach's alpha was done.

3. The study lasted two years, during which some teachers retired, resigned or transferred, which might create skewed results in the research.

4. The unbalanced ratio of private to public schools may provide skewed results.

5. The questionnaire was sent to 150 teachers who met the criteria for the selection of the sample, of which only 100 accepted to respond because traditionally, teachers' busiest time is at the end of the year, and adding to the time demands with a survey was unacceptable to many of them. The non-representativity of the whole population might hinder the generalizability of the survey results.

CHAPTER FOUR

Results, Analysis and Discussion

The purpose of this study was to investigate Middle School Mathematics teachers' attitudes towards integrating computer technology, and their beliefs regarding the impact of integrating computer technology on their effectiveness in class.

This chapter is organized into four sections. The first section provides the number of copies of the questionnaires distributed and the return or response rate, and the characteristics of the surveyed sample. The second section is the consensus analysis of the questionnaire. The third section provides reliability analyses for all the scales. The fourth section compares the two groups of teachers (those who use computer technology and those who do not use computer technology) according to five different dimensions.

Response Rate and Characteristics of Sample

A total of 150 copies of the questionnaire were distributed to middle school mathematics teachers of schools in Saida and Beirut. One hundred filled questionnaires were returned, which results in an overall usable response rate of 66.66%.

The survey asked participants six demographic questions and seven questions related to their computer use (See Appendix A). For all questions, tables illustrate the frequencies and percentages of responses for the overall sample and for each group. However, because the focus here is not on determining group differences on these questions, only the overall percentages are discussed. In terms of demographics, questions regarding gender, age, education, teaching experience, teaching load and department affiliation were considered.

Table 2

Teacher Demographic Information by Group

Demographic Variable	Total (percentage)
Gender	
Male	53 (53%)
Female	47 (47%)
Age	
21-24	5 (5%)
25-29	7 (7%)
30-34	27 (27%)
35-39	24 (24%)
40-44	9 (9%)
45-49	8 (8%)
50-54	11 (11%)
55+	9 (9%)
Education	
Bachelor's	80 (80%)
Master's	17 (17%)
Doctorate	3 (3%)
Teaching Experience	
0-5 years	23 (23%)
6-10 years	23 (23%)
11-15 years	9 (9%)
16-20 years	14 (14%)
21+ years	31 (31%)
Department Affiliation	
Mathematics	100 (100%)
Teaching Load	
Full Time	62 (62%)
Part Time	38 (38%)

The majority of respondents were males (53%). Overall, most teachers were between the ages of 30-39 (51%) and fewest were less than 30 years old (12%). Eighty percent of the teachers surveyed had a bachelor as their highest degree whereas only 17% had a master's degree, and 3% had a doctorate. Almost one third (31%) have been teaching at the school level for more than 20 years, whereas recent mathematics teachers with 5 or less years of teaching experience comprised almost one quarter of all respondents (23%), while almost half of the responding population (46%) had 10 years or less in teaching experience. In terms of department affiliation, all were from the math department (100%). As far as teaching load is concerned, the majority were full-timers (62%). A complete listing of demographic information is shown in Table 2.

The "demographics" section of the survey included a total of seven questions about teachers' use of computers. Two dichotomous questions asked respondents if they owned a computer at home and if they had ever received any type of computer training. Seventy percent of the respondents indicated that they own a computer at home and less than half (48%) had received some type of computer training (see Table 3).

Table 3

Dichotomous Questions on Computer Use

Questions on computer use	Total	
	Yes	No
Do you own a computer?	70 (70%)	30 (30%)
Have you ever received any type of computer training?	48 (48%)	52 (52%)

Four questions targeted the frequencies of usage of particular computer applications such as general computer use, spreadsheets, math software, and the Internet.

Table 4

Usage of Computer Applications

Computer Application	Total			
	Daily	Once a week	Once a month	Never
General Computer Use	12 (12%)	20 (20%)	58 (58%)	10 (10%)
Spreadsheets	3 (3%)	12 (12%)	55 (55%)	30 (30%)
Math software	5 (5%)	13 (13%)	56 (56%)	26 (26%)
Internet	28 (28%)	53 (53%)	13 (13%)	6 (6%)

Respondents had the choice to answer that the frequency of usage of a particular application was: daily, one time a week, one time a month, or never.

Over half of the teachers (58%) reported using a computer in the classroom on a monthly basis. Surprisingly, almost one-tenth (10%) reported never having used a computer, at least at the workplace. Spreadsheets (e.g., Excel) and math software are used on a daily basis in the classroom by only few teachers (3% and 5% respectively), while over half the population (55% and 56% respectively) use them once a month, 30% never use spreadsheets and 26% never use math software. In terms of internet usage by teachers for enriching their teaching ideas, a majority (53%) use internet on a weekly basis. A large percentage of teachers (28%) also reported using the internet on a daily basis. See Tables 3 and 4 for a complete listing of computer usage information.

A question in the "demographics" section included whether the teacher had used computer technology on a daily basis, once a week, once a month or never used it in the classroom. The teachers were then divided into two groups: those who use computer technology in the classrooms and those who do not.

Consensus Analysis

Consensus responses to the questionnaire items were used to answer the research questions. Consensus items were defined by over 70% agreement or disagreement responses on each item of the questionnaire. The difference in attitudes between teachers who use computer technology and those who do not was also examined in three different ways (ANOVA, means and Standard Deviations for Difference Scores, and paired T-tests) to support or to reinforce the results found by the consensus study, and to test the significance of those differences. The factors behind such differences in attitudes were elaborated and given in details by adopting the structured interviews.

Results and discussion will be organized according to the research questions below.

Question 1: Is there a significant difference between the attitudes of teachers who use computer technology and those who do not?

Consensus was found on several items concerning attitudes (enthusiasm, enjoyment, anxiety, and avoidance) in the questionnaire.

There was 100% consensus among respondents on agreeing (agree / strongly agree) with the following items:

- I would like to learn more about computer technology (item 6)
- I would like working with computer technology (item 7)

Most of the respondents arrived to a consensus agreement (over 70%) on the following items:

- I think that working with computer technology would be enjoyable and stimulating (item 1)

- The challenge of learning about computer technology is exciting (item 2)
- I like learning to use computer technology (item 4)
- I enjoy learning how computer technology is used in our daily lives (item 5)
- A job using computer technology would be very interesting (item 8)
- I enjoy computer work (item 9)
- If given the opportunity, I would like to learn about computer technology (item 10)
- Computer technology would help me organize my work (item 17)
- Computer technology solves more problems than it causes (item 18)
- Computer technology helps provide a better learning experience (item 19)
- Computer technology makes the course more interesting (item 20)

There was consensus (over 70%) among the respondents on disagreeing (disagree / strongly disagree) with the following items:

- Learning about computer technology is boring to me (item 3)
- Working with computer technology makes me feel tense and uncomfortable (item 11)
- Working with computer would make me very nervous (item 12)
- Computer technology intimidates and threatens me (item 13)
- Computer technology frustrates me (item 14)
- I sometimes get nervous just thinking about computer technology (item 15)
- There is so much curriculum content to cover that the use of computer technology would be a waste of time (item 21)

It is noteworthy to mention that one item pertaining to this research question did not have consensus agreement or disagreement. More than one third of the respondents were undecided concerning the item:

- I feel apprehensive about using computer technology (item 16)

This could be attributed to the fact that whether the respondents feel positively or negatively towards computers, the apprehension remains. It translates itself into fear when it comes to those who feel negatively towards computers and it translates itself into a sense of responsibility when it comes to those who feel positively towards computers.

The fact that most of the respondents had a consensus agreement on the items that defined a positive attitude concerning computer technology and a consensus disagreement on the items that defined a negative attitude concerning computer technology revealed that teachers who responded to the questionnaire had similar positive attitudes towards computers. In general, there was no apparent difference among the attitudes of teachers who use computers and those who do not. Nevertheless, this difference will be studied more significantly using statistical tests throughout this chapter to verify if these first-hand observations are true or not.

Question 2: How do teachers perceive the impact of using computer technology on the following: (a) the type of mathematical content they teach, (b) their pedagogical skills, and (c) their ability to adapt the curriculum to the students' needs.

(a) The type of mathematical content they teach,

There was 96% consensus among respondents on agreeing (agree / strongly agree) with the following item:

- The use of computer technology allows students to explore challenging mathematical contents (item 31)

There was consensus (over 70%) among respondents on agreeing with the following items:

- Computer Technology is an effective tool for teaching mathematics (item 22)
- Computer technology could enhance remedial instruction in mathematics (item 23)
- Computer technology will relieve teachers of routine duties (item 24)
- Computer technology can be used successfully with mathematical problems which demand creative activities (item 25)
- Computer technology can be a useful instructional aid in mathematics (item 26)
- Computer technology provides better access to real life applications (item 29)
- The use of computer technology allows a teacher to explore important questions and issues arising out of the mathematical content (item 30)
- The use of computer technology allows the teacher to introduce synthesis and analysis into the mathematical content to be learned (item 32)

It is noteworthy to see that 52% of the respondents were undecided concerning the item:

- Computer technology should be used to disseminate class information and assignments (item 28)

This may be attributed to the fact that although most of the teachers believe that computers affect positively the type of mathematical content taught by the teachers in terms of enhancing its real life applications and its analytical value, yet they are still apprehensive and in doubt (undecided) about how to integrate it into their classrooms, and mainly about using networks and communications to interact with students.

(b) The teachers' pedagogical skills:

There was 98% consensus on agreeing with the item:

- Learning to use computer technology is like learning any new skill - the more you practice, the better you become (item 38)

There was also consensus (over 70%) on agreeing with the following items:

- Knowing how to use computer technology is a worthwhile skill (item 39)
- Teacher training of mathematics should include instructional applications of computer technology (item 41)
- Computer technology would increase my productivity (item 42)

There was consensus (over 70%) on disagreeing (disagree / strongly disagree) with the following items

- Computer technology will make a teacher lose authority in the classroom (item 33)
- Computer technology will replace teachers (item 36)
- Preparing a test using computer technology would scare me (item 40)

These, too, are negatively stated items, that called for disagreement by the teachers.

The above consensus shows that teachers' beliefs regarding the impact of computer technology on their pedagogical skills is a positive belief that it will enhance these skills to the benefit of both the students and the teachers.

(c) The teachers' ability to adapt the curriculum to the students' needs.

There was a consensus agreement (over 70%) on the following items concerning the ability to adapt the curriculum to the students' needs

- Computer technology would motivate students in mathematics classes (item 47)
- Computer technology would significantly improve the overall quality of my students' education (item 48)
- Computer technology would stimulate creativity in students (item 50)
- Computer technology would help me as mathematics teacher to open new horizons for students (item 52)
- Computer technology makes the student feel more involved (item 53)
- Computer technology helps the student to learn better (item 54)
- Computer technology increases motivation for the course (item 55)
- Computer technology creates more interaction between students (item 56)
- Computer technology helps students with special educational needs improve their understanding of mathematical concepts (item 58)
- Computer technology helps simplify material and accelerate understanding for students of special needs (item 59)

It can be observed that most items had consensus agreement on them, indicating that teachers had a positive perception of the impact of computers on content, pedagogical skills, and the ability to adapt the curriculum to the students' needs.

Reliability Analyses

There were five domains of interest in this particular investigation. Attitudes towards computers were assessed by examining the dimensions of (a) Teachers' enthusiasm & enjoyment of using computer technology, (b) teachers' anxiety & avoidance of using computer technology, (c) the effect of computer technology on the type of mathematical

content taught, (d) the effect of computer technology on the pedagogical skills and (e) the effect of computer technology on adapting the curriculum to the students' needs.

The five domains were assessed for the 2 groups: those who use computers and those who do not. Cronbach's alpha was computed for each scale at levels and can be seen in Table 5.

Table 5

Cronbach's Alphas for Five Domains (2 groups)

Domain	No. of Items	Not using computers	Using computers
Enthusiasm & enjoyment	10	.95	.96
Anxiety & Avoidance	11	.96	.98
Belief in effect on content	11	.93	.99
Belief in effect on skills	13	.96	.97
Belief in effect on adapting the curriculum to students' needs	14	.94	.95

It is clear that all of the scales demonstrate a high level of reliability with all alphas exceeding .90.

Next, correlations were conducted on the five domains, separately for each group. Every domain was associated with other domains but not with itself (that is domain 1 is associated with domains 2, 3, 4, and 5). Tables 6 and 7 show the results of these correlations. It is noteworthy to point out that the association of domains 1 and 2 is the same as the association of domains 2 and 1, therefore the values were not reported twice in the table and the table tended to be triangular with an empty diagonal (the non-existence of values on the diagonal

was to show that none of these was associated with itself- domain 1 is not associated with domain 1 and this applies for the other 4 domains).

Table 6

Correlations Among Five Domains Examining Teachers' Attitudes Toward Computers (Teachers Not Using Computers)

Domains	1	2	3	4	5
1. Enthusiasm & enjoyment					
2. Anxiety and Avoidance	-.70*				
3. Belief in effect on content	.78*	-.66*			
4. Belief in effect on pedagogical skills	-.71*	-.79*	-.80*		
5. Belief in effect on adapting the curriculum to students' needs	.48*	-.31*	.52*	-.27*	

* $p < .001$

More specifically, Table 6 shows that high level of enthusiasm (domain 1) is positively related to belief of an effect on mathematical content taught (domain 3) and also, but to a lesser extent, positively related to a belief in the effect on adapting the curriculum to students' needs (domain 5) whereas it is negatively associated with anxiety and avoidance. A perplexing result in the above table is the negative correlation between the belief in an effect on skills and the high levels of enthusiasm, the high negative correlation between the belief in an effect on skills and the belief in an effect on content, and the low negative correlation between the belief in an effect on pedagogical skills and the belief in an effect on the ability to adapt the curriculum to students' needs. This result indicates that being enthusiastic about using technology might co-occur with beliefs that technology does not contribute to

enhancing pedagogical skills. This might be attributed to people's conceptions of the computer ruining the skills of teachers and being unable to adapt the curriculum to the students' needs. And not surprisingly, anxiety and avoidance are negatively associated with all the 4 domains indicating that teachers who are anxious about and avoid computers do not enjoy their usage and do not positively think that they will affect the type of content taught or their ability to adapt the curriculum to the needs of the students. The belief in the effects on adapting the curriculum to students' needs is positively related to enthusiasm and enjoyment, which is expected- for the more the teachers are enthusiastic about using computers in their teaching, the more they believe it can positively affect their ability to adapt the curriculum to students' needs. Moreover, there is a positive correlation between the teachers' belief in the effect of using computers on content and their belief in the effect on the ability to adapt the curriculum to their students' needs.

Table 7

Correlations Among Five Domains Examining Teachers Attitudes Toward Computers (Teachers Using Computers)

Domains	1	2	3	4	5
1. Enthusiasm & Enjoyment					
2. Anxiety & Avoidance	-.88*				
3. Belief in effect on content	.94*	-.87*			
4. Belief in effect on pedagogical skills	-.87*	-.90*	-.94*		
5. Belief in effect on adapting the curriculum to students' needs	.89*	-.75*	.87*	-.77*	

* $p < .001$

The relationships for those who use computers are similar (see Table 7), although they appear to be stronger (all of them were above .70, positively or negatively while in Table 6 half of the values obtained were less than .70). For example, there is a high negative correlation between domain 2 (anxiety and avoidance) and all other domains. Moreover, there is a high negative correlation between the teachers' belief in the effect of using computers on content and their belief in the effect on pedagogical skills. Teachers believe that pedagogical skills are independent from the tool used. While the computer might affect the content taught, it does not affect their pedagogical skills. Also the negative correlation between the teachers' belief in the effect of using computers on pedagogical skills and their belief in the effect on the ability to adapt the curriculum to students' needs reflects a discrepancy showing that teachers do not consider adapting the curriculum to students' needs as an integral part of pedagogical skills. For teachers' comparison, analyses were conducted on difference scores which were the scores of those who did not use computers from the scores of those who used computers. They are presented in Table 8.

By looking at Table 8, we can notice that the positive differences indicated a lower mean for those who did not use computers in comparison to those who used computers, and vice-versa for negative values. For example, a positive mean score for the enthusiasm and enjoyment under the difference score in Table 8 indicates that those who used computers showed higher levels of enthusiasm and enjoyment than those who did not. Furthermore, a negative value for Anxiety and avoidance under the difference score column indicate that those who did not use computers in their classrooms had higher levels of anxiety and avoidance than those who used it. A closer analysis of the results shows that teachers using computers in the classroom believe that it has a positive effect on content as well as a positive effect on the ability of adapting the curriculum to students' needs.

Table 8

Means and Standard Deviations for Difference Scores across Five Domains for the two groups

Domain		Difference Scores
Enthusiasm & Enjoyment	M	.86
	SD	1.0
Anxiety & Avoidance	M	-.81
	SD	1.06
Belief in effect on content	M	.65
	SD	.87
Belief in effect on pedagogical	M	-.68
skills	SD	1.05
Belief in effect on adapting the	M	.91
curriculum to students' needs	SD	.96

A perplexing result in the above table is the negative mean for the belief in the effect of computers on pedagogical skills under the difference score column. This result indicates that teachers not using computers believe that a computer has a more positive effect on pedagogical skills than teachers using computers. This might be attributed to people's conceptions of the computer ruining the skills of teachers.

Given the significant results obtained, a series of follow-up ANOVAs were conducted on each domain. Each of the ANOVAs yielded highly significant results and can be seen in Table 9.

In the case of ANOVA, if the calculated value for the F test is greater than the critical value, we reject the null hypothesis and we accept the alternative hypothesis. For this study, the two alternative hypotheses indicate that there is a difference in attitudes and beliefs about integrating computer technology between teachers who use computer technology and those who do not.

Table 9

Analysis of Variance for the two groups

Dependent Variable	Df	Sum of Squares	Mean Square	F
Enthusiasm & enjoyment	1	134.44	1.08	124.64*
Anxiety & avoidance	1	149.73	1.31	114.03*
Belief in effect on Content	1	141.75	1.11	127.60*
Belief in effect on skills	1	162.33	1.42	113.92*
Belief in effect on adapting the curriculum to students' needs	1	135.41	.89	152.52*

* $p < .001$ CV=3.89

Thus the results of the ANOVA given in Table 9 indicate clearly the presence of such a difference between the two groups of teachers.

Since the results of difference scores and the statistical tests across domains reveal that differences were positive in some places and negative in other places and since ANOVA justifies the significance of this difference then it can be said that the group that used computers showed more favorable attitudes toward computers in the form of significantly higher enthusiasm, enjoyment, and lower anxiety and avoidance. It also shows increased

beliefs of teachers concerning the positive impact of computer usage on content, and on the ability of adapting the curriculum to students' needs.

To reinforce these results, the means and standard deviations of the 2 groups were considered. The results are presented in Table 10 for each domain. The results of Table 10 are another expression of the results obtained in Tables 8 and 9.

Table 10

Means and Standard Deviations for Scores across Five Domains for the two groups

Domain		Not Using Computers (N=10)	Using Computers (N=90)
Enthusiasm & enjoyment	M	3.35	4.21
	SD	.90	.77
Anxiety & avoidance	M	2.64	1.90
	SD	.98	.70
Belief in effect on content	M	3.85	4.34
	SD	.75	.57
Belief in effect on pedagogical	M	2.20	1.46
skills	SD	1.10	.47
Belief in effect on adapting the	M	3.23	4.14
curriculum to students' needs	SD	.72	.91

We can again see that teachers believe that the use of computers has a positive impact on enthusiasm and enjoyment, the belief in effect on content, and the belief in effect on adapting the curriculum to the students' needs, while it has a negative impact on anxiety and avoidance and the belief in effect on pedagogical skills.

Paired T- tests for teachers who use and those who do not use computer technology

In examining the results of the ANOVA, it was thought that additional analyses may be necessary to compare the group that uses computer technology and the group that does not. A series of five paired t-tests were conducted on each dimension to determine differences that occur in every individual dimension and whether these differences were significant or not. Due to the increased number of analyses, a p-value of 0.001 was used to determine significance and protect against Type I errors.

Table 11

Paired T-Tests for teachers who use computer technology Across Domains

Dependent Variable	Df	Mean Difference	Standard Deviation	T
Enthusiasm & enjoyment	88	.86	1.00	8.10*
Anxiety & avoidance	88	-.81	1.06	-7.17*
Belief in effect on content	88	.65	.87	7.01*
Belief in effect on pedagogical skills	88	-.68	1.05	-6.12*
Belief in effect on adapting the curriculum to the needs of students	88	.92	.96	8.92*

* $p < .001$ CV=5.82

As Table 11 indicates, all of the T-tests were significant (their absolute values are greater than the critical value of the t-test at the given degree of freedom). For those who use computers, we can see that we have obtained a positive value for the T- tests for the domains of enthusiasm and enjoyment, belief in effects on content, and belief in effects on adapting the curriculum to students' needs. Whereas, we had a negative value for the T- test for the

domains of anxiety and enthusiasm and the belief in effects of the computers on pedagogical skills. This positive value shows again that those who use computers enjoy its usage and believe that it has a positive impact on content and on adapting the curriculum to the students' needs.

We can see that this result was inverted for those who did not use computers (See Table 12). In this case, the positive values for T-tests became negative and the negative values for T- tests became positive. This is not surprising; for those who do not use computers are expected to have a positive value for anxiety and avoidance and a negative value for domains such as their belief in effects on content and ability to adapt the curriculum to the students' needs.

Table 12

Paired T-Tests for teachers who do not use computer technology Across Domains

Dependent Variable	Df	Mean Difference	Standard Deviation	T
Enthusiasm and enjoyment	8	-.77	1.07	-8.13*
Anxiety and avoidance	8	.90	1.20	8.27*
Belief in effect on content	8	-1.01	1.17	-9.59*
Belief in effect on pedagogical skills	8	1.08	1.29	9.27*
Belief in effect on adapting the curriculum to students' needs	8	-.70	.93	-8.39*

* $p < .001$ CV=5.82

The means and standard deviations for difference scores can be seen in Table 8 and Table 10. The significance of these T- tests indicates that the differences that we saw across

individual domains (the positive indicators for those using computers on enthusiasm and enjoyment and the negative effect on anxiety) were significant findings. That is, the results obtained are certain, since they have been tested in 3 ways (ANOVA, difference of scores, and paired T-tests), and the findings are similar.

Post-hoc Data Analysis

After the data that was found in the previous sections was analyzed, the dramatically negative attitudes by those who do not use the computer technology were re-examined. After removing deviant scores list-wise from both groups, (those respondents that contained a domain change greater than or less than a shift in 2), those respondents who used computer totaled 88 and those who did not use computer technology respondents totaled 9, for a total of 97 respondents. ANOVA was again conducted on each domain. Analyses were conducted on difference scores which were the scores of those who did not use computer technology subtracted from the scores of those who used computer technology. Each of the ANOVAs continued to yield highly significant results. In each case, the group that used computer technology continued to show more favorable attitudes toward computer technology in the form of high levels of enthusiasm, enjoyment, and low levels of anxiety and avoidance.

To examine further the cause of the dramatic negative attitude of teachers who do not use computers, a content analysis was performed. In observing the surveys, it was noted that many comments were made by respondents. Using common keywords, comments were assigned to separate groups, such as "repetitive questions," and "inapplicable questions." For example, item 58 in the questionnaire states the effect of computer technology on special needs students. Many of the respondents indicated that they know nothing about special needs students. Many respondents indicated that a "not applicable" category would have been helpful.

Although these post-hoc efforts were made to help determine causes for the unexpected negative attitudes, the researcher believes that the first set of data, including the deviant scores, should be maintained when considering the results.

Analysis of the interviews

The teachers' beliefs and attitudes towards the integration of computer technology in mathematics instructions are important, as these teachers can inhibit or catalyze the implementation of the technology. In order to assess the teachers' attitudes towards integration, the method of structured interviews has been adopted. The teachers accessed through this method are eight chosen from private and pubic schools in the two cities, Saida and Beirut, in Lebanon (See Table 1).

For these interviews, five questions have been developed, based on the pattern of the questionnaire for the survey. They allow the researcher to identify key attitudes, and supply specific type of information misunderstandings. The responses of 8 interviewees with diverse backgrounds were analyzed. For this reason two groups were set up for the different teachers in order to find out the general opinion in this group. The following groups were created:

1. Teachers who are considered as not using computer technology for improving their effectiveness in the classroom or for teaching purposes. These three teachers use computer technology for checking e-mails, typing exams and organizing their grade books in order to calculate students' averages.

2. Teachers who are considered as using computer technology for improving their effectiveness in the classroom. These five teachers use computer technology for presenting lectures, exploring some geometric properties in class using dynamic geometry software, searching for new ideas for teaching or lesson plans in some useful websites on the internet,

getting extra material and worksheets for their students and reading about new developments such as reading articles and getting to learn about software.

After setting up the two groups, the data coding was organized to define patterns in the transcriptions of the interviews. This process involved reading transcriptions to get a sense of the whole, identifying codes, and grouping categories of data together according to the codes. Two main coding categories were formed as well as subcategories under each.

The first category is about teachers' attitudes towards computer technology integration and its subcategories which are the factors behind such attitudes. Although the majority of the interviewees had bad experiences with computer technology due to many reasons, this was not the only barrier or obstacle for implementing or integrating computer technology in their classrooms. Effective technology use is a complex process of planning and ongoing support with serious consideration of the current and emerging research findings on its use. Many aspects can inhibit or catalyze the implementation of the technology. According to the interviewees, these aspects are the following:

Teacher time issues. Time is a critical factor. Teachers feel that they have to invest time in developing a technology lesson for the classroom. Three teachers stated time constraints as obstacles for the integration of technology. One teacher stated that he "had problems with scheduling enough computer time to fit into teaching hours" .The second one affirmed that, "technology is moving quickly and often faster than teachers". The main obstacle foe her was that she has no time to catch up. And the third teacher referred to technology as time consuming when it comes to planning and especially if the teacher was overloaded with teaching hours, work and corrections.

Access. It seems that the type of access and availability of hardware and software in the school usually dictates the type of teaching strategy used to incorporate the technology into the lesson. Some teachers are resistant because their access to technology is limited. One teacher expressed this by saying that, "our school does not have a computer lab- we barely had a few computers that students have to share". A second teacher affirmed that, "availability of hardware and software is for me the utmost".

Support issues. Supporting teachers in their endeavor to implement technology in their teaching takes different forms:

Administrative Support. The school culture and the administrative support is one of the most important factors affecting computer technology integration. One of the teachers had no bad experiences with the computer and describes it as fun to work with and as she said, "that was a result of an administrative support and an IT department at school that is there to help with any problem". Teacher training is a part of administrative support.

Teachers suggested the necessity of an effective support for technology use, portrayed in providing long term staff development (both in-service and pre-service training) through workshops, encouraging, modeling, and technical training for teachers to infuse technology into their daily teaching strategies. One teacher recommended that "Schools must work toward supporting and promoting change in teaching roles and practice that use new technologies". This kind of support will increase the teachers' level of knowledge and consequently would raise their level of confidence and therefore reduce the tension and increase their productivity.

Technical Support. The more teachers experiment with different programs and the more chances they take working with the computer with their students, the better they get at using

the computer and solving its endless problems in class. Six teachers out of eight reported having bad experience as a result of technical problems. To get over the feeling that they have to know everything, they have to get used to the fact that they are not always the teacher in the classroom. Technical support from experts in the field of technology, or even some well-informed students, is required. Sometimes these students may help the teachers in things they didn't know, so this inability of teachers to trouble-shoot a problem in front of students must not be a crisis and must not make them feel embarrassed.

Teachers recommended that technical support for technology use has to take the form of an ongoing technical assistance or an "IT department that is available in schools to help teachers trouble-shoot any problem when needed" as one of the teachers mentioned.

Financial Support. "The expense of frequent upgrades might prohibit the schools from replacing the computers and software that they had to work with very often", a teacher said. Four teachers affirmed that the non- integration of technology is due to inadequate financial support, such as "too few computers for the number of students and too few printers ", "the school does not have a computer lab- they barely had a few computers that students have to share ", "I hope that our school had more advanced computers" and "use of computers needs software that the school was not ready to pay for".

Teachers recommended that one of the major factors necessary to support the effective integration of computer technology in mathematics classrooms is the financial support for technology use which has to be recurrent. The most important thing, as suggested by interviewees, is the availability of computers and the frequent upgrades of hardware and software in schools to ensure access to appropriate technology.

Teachers need different kinds of support, if integrating technology is to become a reality, This support would help them continue their progress in using technology in their classroom

but it would not be enough to get teachers started integrating computer technology. One teacher attributed the effective integration of computer technology in mathematics classrooms to a technology implementation plan designed by the government, by saying, "there must be a vision and a general policy all around the country that supports this integration of computer technology".

Planning. Effective planning, which is a main area of support that is sometimes overlooked, is an extremely important aspect of technology integration and teachers need guidance in this area. The teachers felt that technology lessons take more time to plan. One teacher considered planning technology lessons as frustrating and time consuming for her, because of her lack of experience. She expressed this by saying, "The time required to plan and develop new technology lessons made me feel as if I am a first-year teacher working through new material or curriculum".

So much attention is paid to learning how to operate the hardware and software, that it almost seems taken for granted that a teacher will instinctively know how and when to exploit it in the learning context. Organizing a classroom lesson involves making decisions about which instructional strategy would be most effective for the lesson and the students. Teachers have to understand the technology application well enough to understand how it will best be used in the classroom. In agreement with what was mentioned, three teachers acknowledged that, "deciding when technology is the best teaching tool to use is important", "using technology appropriately and not just to use it for all instructional objectives is an important consideration", and "it depends on what is the teacher using the computer for. But anyway I feel a responsibility to provide my students with experiences that would be helpful to them in the future". One teacher added that "teachers who can match technology use to the

objectives of the new curriculum are much better than those still using traditional methods of teaching".

The teachers also saw changes in their teaching role in the classroom when they design technology lessons because the students were actively involved. One teacher explained that teaching with technology allowed her to teach more "as a facilitator than primary instructor". Most of the teachers felt that if the technology lessons were well designed and planned, then the classroom management would be easier than on a traditional teaching day.

For the good preparation of computer technology integration, teachers suggested that they must be offered enough time to plan, learn about, develop new technology lessons and implement technology applications. They considered that the involvement of teachers in planning classroom uses of technology and deciding when technology is the best teaching tool to be used is essential in order to suit technology to education goals.

Knowledge level. Acquiring technology knowledge and skills is essential for the integration of computers. The level of understanding the teacher has about the technology resource itself is one factor in determining how well the teachers will be able to integrate it successfully into their teaching. Some educators are resistant to computer integration because they are uncomfortable with technology. One teacher affirmed that "teachers need to be willing to stretch outside of their comfort zone when incorporating technology into their classrooms". Another teacher considered "teachers who use technology are more up to date; this is the type of people who always seek to improve themselves and thus they are better teachers".

Confidence level. Teachers' confidence level is impacted by their ability to use technology in teaching mathematics. The process of creating and designing instruction by

using technology will enhance teachers' knowledge and in turn motivate a transition in teachers' beliefs and confidence. Only equipped with strong confidence and profound knowledge, teachers can achieve success in mathematics teaching. One teacher described herself as a risk taker "since technology is still kind of new and there are so many new things out there and they're always changing and they're afraid that they'll do something and it'll be outdated next week". Whereas, a teacher who uses computer technology in her classroom said that, "I am more comfortable with students working independently. Exploration makes them appreciate mathematics and gives it new meanings"

The second category and its subcategories is about the teachers' beliefs regarding the impact of this integration on their effectiveness in the classroom which is portrayed in the following

Type of mathematical content they teach. The majority of the interviewees expected that using computer technology will have a positive impact on the type of content they teach. One teacher considered that using technology would enable the teacher to present more complex material to students. Another expected "more from students in terms of their pursuing and editing their work or projects". A third teacher claimed that "changing to use technology lessons is a way to keep the students interested in learning the content material" and by exploration students will appreciate mathematics and give it new meanings", a teacher added.

However, one teacher considered that technology integration will not affect the type of content taught. She addressed this by saying, "I think that good teachers are those who know the material well not those who know how to open or close a computer. Computer technology will add nothing to such teachers".

Their pedagogical skills. Only two teachers considered the use of computer technology as something which enhances the pedagogical skills of the teacher. One claimed that technology will add to the skills of the teacher and will change his or her role by making the teacher "a facilitator rather than a primary instructor" by letting students work and explore the problems on their computers and then find their own solutions.

Their ability to adapt the curriculum to their students' needs. Most teachers interviewed approved that computer technology integration would enable the teachers to adjust the content to students' needs. This was confirmed by saying, "technology helps me teach to the different learning styles of students in my classes". Others agreed that they can "spend more time with individual students to work with them on the computers", "focus on different ways of teaching to bring in all of the tools, to help students learn", and "tailor instruction to individual student needs".

With respect to the changes in their students' understanding or their classroom techniques due to computer technology, the two groups expected the following:

1. The group of teachers not using computer technology expected to (a) present more complex material to their students, (b) demand more from students in terms of their pursuing and editing their work or projects or (c) have no change.

2. The group of teachers using computer technology expected the ability to (a) spend more time with individual students to work with them on the computers in order to bring in the tools, suitable for their different modes, to help them learn (b) be more comfortable with students and stimulate their creativity by letting them explore and work independently so as to appreciate mathematics and give it new meanings and (c) tailor instruction to individual student needs.

As to the question about teachers' beliefs regarding "better teachers", most interviewees agreed on considering those using computer technology as better teachers since the computer adds to their skills, makes them responsible, more up to date and more improved and this, of course, affects their teaching practices, whereas two teachers considered that the teachers' level of knowledge, not the use of technology, is the most important factor in classifying a teacher. Thus, some teachers have positive attitudes towards integrating computer technology, but they think that obstacles must be defeated first.

Data Analysis Summary

The data analysis presented in Chapter 4 provided a basis for developing the conclusions and recommendations that follow in Chapter 5. All usable questionnaires were analyzed and the respective information was discussed in narrative form and presented in tables where appropriate. The four sections of this chapter provided an in-depth look at survey demographic findings, the characteristics of the population, a consensus analysis, and a group comparison using difference scores, ANOVA and paired T-tests. The chapter provided specific findings for the study's major two research questions, which will be summarized and discussed in Chapter 5.

CHAPTER FIVE

Summary, Conclusions and Recommendations

The purpose of this chapter is to summarize the significance, literature, methodology, procedures, and results of this study. On the basis of the results, conclusions and recommendations are provided in support of the following research questions:

1. Is there a significant difference between attitudes of teachers who use computer technology and those who do not?

2. How do teachers perceive the impact of using computer technology on the following aspects: (a) The type of mathematical content they teach, (b) their pedagogical skills, and (c) their ability to adapt the curriculum to students' needs.

Summary

The review of related literature showed that although many studies have previously been done to determine teachers' attitudes toward the integration of computer technology, fewer have been done to examine the teachers' beliefs regarding the effect of such integration on the content, pedagogical skills, and ability of adapting the curriculum to the needs of the students. There were several issues discussed in the literature review: teachers' beliefs about, and attitudes toward computer technology, obstacles to technology use, computer technology training methods, and teachers' integration of computer technology.

Why are mathematics teachers apprehensive to integrating computer technology into current teaching methods? The analysis of structured interviews showed that the reasons include fear of change, lack of time, lack of knowledge about computer technology resources for specific course content, and rapid changes in hardware and software developments.

Teachers also need to have the ability to observe computer technology modeling by colleagues. However, most school policies have put such a low priority on computer technology training, thus teachers may have perceived that computer technology training and subsequent integration have little monetary reward or recognition. It is also difficult for teachers to see the value in learning any new teaching methods, whether or not these methods are computer technology-related.

The survey responses supporting the need for integrating computer technology in mathematics classes also agreed with the literature. The literature review indicated that teachers are more likely to adopt the use of computer technology, both personally and in the classroom, after receiving training. Lack of training is one of the greatest obstacles faced by teachers. This affects their attitudes and desires to learn new computer technology and to integrate computer technology into their classrooms. The literature review showed that the usage of computer technology in mathematics classes must be continual and sustained, for any degree of proficiency to be maintained. Various types of training for teachers to use computer technology have been attempted throughout educational history, but the models with the most success are workshops, one-on-one training, and colleague mentoring. Evaluation and follow-up are also important considerations.

As new technologies are created almost daily, there are new opportunities for teachers to incorporate them into current course content. These new technologies necessitate the need for a cyclical curriculum development pattern. One of the newer methods of computer technology integration has been the use of the World Wide Web (the Web). There are advantages and disadvantages to using these sites for curriculum development. One of the obvious advantages to this type of training is the cost to the school. There are usually low or no participation fees. Major disadvantages, however, include the lack of personal interaction

and the problem of self-motivation. A method that has been found to be more effective for computer integration in mathematics classes is the use of mathematics software. These are effective, however, only when the usage is cyclical; that is, as further information technology is made available, the math software usage is more and more taught to students, with as many demonstrations as possible. However, one of the most important discoveries in this study is the need to further examine methods of computer technology usage to determine those that are the most effective and appealing for mathematics teachers. Indeed, teachers' attitudes and motivation showed to be key factors in the process.

After reviewing the literature, a 59-question survey was used to obtain information about teachers' attitudes for those using computer technologies and those not using computer technologies. The resulting instrument consisted of 5 domains. These domains were: (a) enjoyment/enthusiasm, (b) anxiety/avoidance, (c) Belief in effects on mathematical content (d) Belief in effects on pedagogical skills, and (e) Belief in effects on their ability to adapt the curriculum to students' needs. Also included in the instrument was a demographic sheet (See Table 2). The demographic sheet contained such information as age, gender, department affiliation, previous training, and computer use practices.

The survey population (N=100) consisted of full-time and part-time mathematics teachers in Saida and Beirut cities. There were 62 full-timers and 38 part-timers. Participants were all teachers affiliated to the mathematics department. Computer technology attitude surveys were distributed to the teachers at different school campuses. Valid responses were received from 100 teachers for a total response rate of 66.6%. Although these rates were considered to be acceptable, the surveys were distributed in June, which unfortunately coincided almost exactly with the end of the academic year which is teachers' busiest time. Already limited time constraints, more than likely, had an effect on the willingness of

teachers to complete the final survey (Some teachers considered adding to the time demands with a survey was unacceptable).

After the survey collection, several data analyses were performed. Cronbach's alpha was computed for each domain to determine the reliabilities for each domain. All domains demonstrated a high level of reliability, ranging from .93 to .99.

Correlations were computed and all domains were found to be associated with each other. More specifically, high levels of enthusiasm and enjoyment were indicated to be positively related to teachers' beliefs in the effect of computer technology on content. As anticipated, high levels of enthusiasm and enjoyment were negatively associated with anxiety and avoidance. Anxiety and avoidance were negatively associated with all other domains.

Following these steps, an ANOVA was conducted on each domain. Five paired T-tests were also conducted on each domain. The anticipated results were that teachers' attitudes would increase favorably with actual use of computer technology.

Because of some unexpected results (the negative correlation with the belief in the effect of computer technology on pedagogical skills with using computers, and the negative value of the T-tests obtained), several post hoc analyses were carried out to see if an explanation within the statistics might provide answers for these unexpected results. First, the deviant scores were removed from the statistical data and the results recalculated. To qualify as deviant, scores were removed that were either greater or less than a shift in 2 (using a Likert scale of 5). Although the resulting statistics were not as dramatic, the direction of the statistics remained the same. In other words, teachers' attitudes continued to be more positive following the use of computer technology while they showed always a negative tendency of the belief in the effect of using technology on the pedagogical skills of teachers.

In addition to these statistical recalculations, a content analysis was done on the comments that were attached to many of the surveys. The greatest percentage of comments stated that many of the questions in the survey were "inapplicable". The researcher did not feel as if these post-hoc results were adequate reasons to support the dramatic decline in belief when it came to the effect of using technology on pedagogical skills. Therefore, it is recommended that any future reviewers of the statistics in this study maintain the results of the original statistical analysis (prior to the post-hoc study). The following portions of this chapter include the conclusions and subsequent recommendations drawn from the findings of these statistical analyses.

Conclusions

The conclusions of this study were based on the data collected from the questionnaires and interviews and are assumed to be characteristic of the teachers surveyed and interviewed. The anticipated result of this study was that those teachers who use computer technology would have an increasingly positive attitude toward computer technology and more positive beliefs about their performance and teaching abilities compared to those who do not use computers.

Although this assumption was found to be true, the dramatic decline in beliefs concerning the effect of computers on pedagogical skills by the second group who used computers was unexpected. It is believed that the age of some of the respondents played an important role. The older generation who were not accustomed to using computers in the early years (since computer usage appeared later in their lives), thought that computers may ruin the pedagogical skills of teachers, or, at least, may not contribute to improving pedagogical skills that were built during many years of experience. Their conception of a

teacher who uses the chalk and lectures in front of students is the more prevalent in the back of their minds.

The survey included a demographic sheet containing such information as age, gender, teaching experience, and final degree obtained. Several of these factors may have played an unanticipated role in attitude shifts. For example, approximately 43% of the teachers have 0-5 years of teaching experience. It should be taken into consideration, then, that those teachers who are newer to the field may have more positive attitudes than those who are not. These results indicate that those teachers with the greatest length of teaching experience may be more reluctant to adopt new teaching methods, such as the integration of computer technology. The literature review indicates that it is sometimes more difficult for longer-term teachers to adapt new instruction methods, and this is supported in the statistical analysis.

Training for the use of computer technology was also an issue examined in the demographics. Close examination of the demographic data revealed that less than half (48%) of the total respondents had received previous training. In addition, nearly two thirds of the teachers (70%) own a computer at home. The assumption was made, therefore, that although teachers have their home computers; their needs for computer technology at the workplace are very different and thus require different approaches. Even though they use the computer general applications (word processing for preparing their worksheets and exams, spreadsheets for managing their grading systems, etc.), they need more systematic training in pedagogical strategies and approaches that use mathematical computer applications for teaching.

The specific conclusions for each survey subscale are summarized in the following five sections of this chapter: (a) enthusiasm/enjoyment, (b) anxiety/avoidance, (c) Beliefs in effects on content, (d) Beliefs in effects on skills, and (e) Beliefs in effects on better adapting the curriculum to the needs of students.

Enthusiasm and enjoyment. The survey included ten questions specifically requesting information about the teacher enthusiasm and enjoyment of computer technology. Means were computed and compared for both groups: those who use and those who do not use computer technology. As anticipated, enthusiasm/enjoyment showed a higher level in positive attitude in the group that uses computer technology in class versus the group that does not. However, the second group showed an unexpectedly dramatic low level in their enthusiasm/enjoyment. As noted previously in this chapter, factors that may have contributed to this low level include timing of the final survey.

Anxiety and avoidance. The survey included eleven items regarding anxiety toward computer technology use. The results of the survey indicated that for the teachers who used computer technology, computer technology anxiety is significantly lower. Although it was anticipated that for those teachers who did not use computer technology, anxiety level might possibly be high, the difference in the survey results were surprising. The mean for those who do not use the computer technology dropped from 2.64 to 1.90. It is believed that a perceived lack of financial support by administration for computer usage and required integration are among factors that may have caused this dramatic drop. Without training, teachers are reluctant to adopt new teaching methods, especially on computers with which they are not familiar.

Teachers' beliefs regarding effect on mathematical content. The third section of the survey included eleven questions regarding content improvement. The results of the survey showed that teachers believed in the effect of using computer technology on content improvement. The means for those who do not use computer technology versus those who use it increased from 3.85 to 4.34, both statistically significant and dramatic. In other words, teachers perceived that the use of computer technology was an important factor that would

help them to deliver better content. The reverse was seen again in the group that did not use computer technology, with a decreased mean. This larger decrease again supports the supposition that lack of training plays a significant role in teachers' willingness to continue to learn new technologies.

Teachers' beliefs regarding effect on pedagogical skills. The fourth section of the survey included 13 questions regarding whether teachers believe in the effects of computer technology on their pedagogical skills. The results obtained here were perplexing. The negative statistics found in the difference scores and in the paired T-tests came as a surprise. They indicated a non–understanding of the concept of pedagogical skills. It seems that the respondents were associating a higher usage of computers with a lower dependency on the usage pedagogical skills. However, the ANOVA showed slightly different results.

Teachers' beliefs regarding effect on better adapting the curriculum to the needs of the students. The final section of the survey included fourteen questions regarding the teachers' beliefs in an impact on their ability to better adapting the curriculum to the needs of the students. The results of the survey indicated that the use of computer technology had a positive effect on the ability of teacher to adapt the curriculum to the needs of the students. The use of computer technology showed a slight positive change in that belief.

Why were the results of those who do not use computer technology so dramatic? Several external factors likely contributed to the unexpected low level in attitude toward computer technology. Another factor the researcher received from interviewed teachers was that, although teachers enjoy what computer technology can do for them, they simply want to continue to use what they currently have. One factor is that, traditionally, teachers' busiest time is at the end of the year, and adding to the time demands with a survey was unacceptable to many of them. Another reason that the declining attitude was greater is a perceived lack of

support from administration by the lack of training. When administrators show little support by reward or recognition, teachers are less likely to adopt computer technology for their teaching purposes.

The growth of the distance learning field has added new implications to computer technology usage. This rapidly developing area has brought new dimensions to teaching methods, and shifts from those with which teachers are currently comfortable. An obvious positive effect of distance learning (getting extra material or ready-made lessons from the internet) is that teachers who are not geographically able to attend traditional training sessions on the use of the computer technology in mathematics classes can still obtain developing information. However, there are several problems associated with distance learning. One particular problem of distance learning is the loss of personal contact between teacher and student. In addition, very few teachers have had training in how to present information on camera to students. Distance learning is a computer technology issue that has grown tremendously in the last several years and continues to grow. It is an important issue for administrators to consider when addressing computer technology training. How teachers will be trained to incorporate this new teaching style and compensation for doing so are issues that must be considered.

Being compensated for learning new teaching methods is another issue. Teachers are reluctant to attend technology seminars and learn new technology methods when there is no monetary or promotional reward or recognition. Generally, mathematics school teachers have a commitment to their specific field, and attending seminars or workshops outside their special ground is not a priority. If monetary or promotional rewards are not possible, then other considerations must be made by administrators about how to compensate teachers for the required time commitment and effort to learn new teaching techniques. Although

administrators are requiring that teachers know how to use this technology, the benefits of this time investment by teachers are unclear.

Other reasons for the negative attitudes in the group that does not use computer technology include the fact that some teachers are simply not interested in adopting new teaching methods. As mentioned, some teachers find it embarrassing when students display a greater knowledge about computer technology than they as teachers do know. Students are graduating from middle school and arriving at high school with more knowledge about information technology than teachers. These students have a great advantage over teachers – They have had years of experience and "training". The new Lebanese curriculum guidelines state that students shall have basic word processing by the third cycle (ages 11- 15). By the time they arrive to the end of the middle school, these students will have a proficiency in computer technology far beyond that of some of their teachers. Teachers simply don't have the necessary time to devote to learning the new technologies with which these students have been provided. It is important, however, for teachers to keep up with "the basics". As recommended below, technology committees that are comprised of curriculum developers, administrators, teachers, and students should help teachers know what those basics are on a continuous basis and should guide administrators in adequately supporting teachers in their quest for new technology knowledge. But most of all, the important thing is that computer technology should be a part of a coherent mathematics curriculum, that is engaging and rigorous, as well as the assessment such as official and school exams in the country.

To summarize the answer to the first research question, it is the conclusion of this study that there were significant differences in the attitudes of teachers who used computer technology versus those who did not. The conclusion for the second research question showed that teachers' beliefs regarding the positive impact of computer technology were on

the type of mathematical content taught by them and on their ability to adapt the curriculum to the students' needs. To combine the results of the two research questions, it can be said that those who use computer technology have a much more positive attitude than those who do not. In fact, those who do not use computer technology are seen to have negative attitudes toward computer technology in general and do not believe that it will help them develop their curriculum content to better adapt it to the needs of their students.

Recommendations

The results of this study have determined that there is a positive shift in attitude among those teachers who use computer technology. The study, therefore, has identified the need for specific recommendations to be made to curriculum developers and to school administrators to improve further their teachers' attitudes toward computer technology.

There is a critical need to examine the type of training that has the greatest positive impact on teachers. Many studies have attempted to do so but schools seem to be making training decisions haphazardly. Many teachers have had informal lessons in learning to use available technology, but still there is no substitute for formal computer technology training. Although workshops revealed to have the greatest effect in the introduction of new material, learning to integrate computer technology requires more intensive, long-term training. This needs an additional support of trained personnel to help teachers plan, maintain and coordinate the use of computer technology.

Unfortunately, planning and training often follow the purchase and installation of new equipment. In many cases, new computer technology is introduced into student work areas long before plans have been made to train teachers in those new technologies. It is prudent from the start to assess and identify possible computer technology additions that must be

incorporated with effective training to increase the probability of integration by teachers. As Borko and Putnam (1995) argued, for such training plans to be effective and successful, they should embody several key features of teacher learning programs. These include an explicit focus on teacher learning and knowledge expansion, opportunities for teachers to examine their beliefs about teaching and learning, programs that reflect the assumptions about teaching and learning held by the designers of computer mathematics software, and opportunities for teachers to construct their own knowledge in an environment that supports and encourages risk taking and reflection.

Moreover, one agrees with what Putnam and Borko (1997) suggest, teachers need to construct their complex new roles and ways of thinking about teaching practice within an atmosphere of supportive learning communities. By engaging in conversations about teaching practices, teachers have opportunities to learn to be critical and reflective of their own teaching and these communities provide such opportunities for learning. For these conversations to be a resource for teachers, they must take place within a supportive, but challenging, environment for reflection and inquiry.

Moreover, training and providing the tools (equipped labs) is not enough so that teachers integrate the computer technology into their curriculum. Teachers should be encouraged to integrate new technologies into their curricula, to try to change their content to suit the demands of the students, and to try to enhance and renovate their pedagogical skills.

Using the results of this research and examining other research into computer technology integration into mathematics classes, curriculum developers and administrators should be able to see more clearly the meaningful ways for supporting the increased use of computer technology in mathematics classes at the middle school level, computer technology training, and the development of strategic computer technology integration plans because the school

culture or environment plays an important part in supporting or constraining classroom changes that are brought about by the introduction of technology.

Professional development of teachers is very important in addition to outlining effective pedagogy. A simple advice to curriculum developers, first, is that teachers who can see beyond what has been done to what could be accomplished must be included in the process of curriculum development, regardless of the select group of educators working independently who are primary in the process. Teachers are the best source of information about what specifically will and will not work in a classroom. They bring a strong note of reality to the process, through their familiarity with schools, communities, and the classroom environment. And, second, is that the students must be in every consideration. Curriculum developers have to discover the personal needs of the students. They must consult students and listen carefully to what they say because their views are a primary source of data to guide curriculum development. For this reason, field testing is an important component in the development process. To do this, we need a curriculum team that is committed to: (a) Developing curriculum that is challenging, rigorous and engaging and (b) providing the necessary support structures so that all students have access to the needed relevant knowledge.

As mentioned above, the computer technology integration plans should include forming committees of curriculum developers, administrators, teachers, and students. Important issues for those committees should include also the acquisition of current hardware and software, availability of hardware and software for all teachers and students, an increase in teacher awareness of computer technology resources, effective training, evaluation and follow-up methods, and incentive systems (monetary and promotional rewards). Teachers are more likely to have a willingness to integrate computer technology into the mathematics classroom

when there is a commitment from administrators, upgraded equipment, support personnel, and effective long-term training.

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APPENDIX A

Questionnaire

Dear Colleagues,

I am pursuing a master's degree in Education at the Lebanese American University. The topic of my thesis is attitudes of Middle School Mathematics teachers towards integrating computer technology in their teaching and their beliefs regarding its impact on their effectiveness in class. This survey is a requirement to the completion of my thesis.

Your involvement in this study is meaningful and sincerely appreciated. Please complete all four pages of this questionnaire and personally hand it to me or to a designated person in school who will pass the questionnaires to me. Obviously, the success of my research depends upon your cooperation. Please sign the following section.

I understand that by returning this questionnaire, I am giving my informed consent as a participating volunteer in this study. I understand the basic nature of the study and agree that any potential risks are exceedingly small. I also understand the potential benefits that might be realized from the successful completion of this study. I am aware that the information is being sought in a specific manner so that no identifiers are needed and so that confidentiality is guaranteed. I realize that I have the right to refuse to participate and that my right to withdraw from participation at any time during the study will be respected with no coercion or prejudice.

Signature _____

Thank you for your interest in my thesis. Should you have any questions, please call me at home 961-07-721042 or send me an e-mail at narouni@hotmail.com.

Thank you once again for your cooperation.

Sincerely,

Nazmieh Arouni

LAU- Program of Master in Education

All responses to this questionnaire are kept confidential.

The purpose of this questionnaire is to gather general information concerning beliefs and attitudes toward the use of computer technology.

Age:

1 21-24 2 25-29 3 30-34 4 35-39
5 40-44 6 45-49 7 50-54 8 55+

Education:

1 Bachelor's degree 2 Master's degree 3 Doctorate or professional degree

Gender: 1 Male 2 Female

Do you have a computer at home? 1 No 2 Yes

How often do you use a computer in the classroom for teaching mathematics?

1 Daily 2 Once a week
3 Once a month 4 Never

How often do you use a spreadsheet program in the classroom for teaching mathematics?

1 Daily 2 Once a week
3 Once a month 4 Never

How often do you use a Mathematics software (derive, Logo, Cabri, etc) in the classroom for teaching mathematics?

1 Daily 2 Once a week
3 Once a month 4 Never

How often do you use the internet for enriching your teaching ideas?

1 Daily 2 Once a week
3 Once a month 4 Never

Have you ever received any type of computer training? 1 No 2 Yes

Where did you receive your computer training (check all that apply)?

1 Self taught 2 College or University
3 Computer Commercial Center 4 Other (specify) _____

Are you: 1 **part-time teacher** 2 **full-time teacher**

How long have you been teaching? _____

Department: _____

Name: _____ **Date:** _____
(Please Print)

E-mail: _____

Instructions: Please read each statement and then mark the column, which best shows how you feel.

SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree

		SD	D	U	A	SA
1.	I think that working with computer technology would be enjoyable and stimulating.	1	2	3	4	5
2.	The challenge of learning about computer technology is exciting.	1	2	3	4	5
3.	Learning about computer technology is boring to me.	1	2	3	4	5
4.	I like learning to use computer technology.	1	2	3	4	5
5.	I enjoy learning how computer technology is used in our daily lives.	1	2	3	4	5
6.	I would like to learn more about computer technology.	1	2	3	4	5
7.	I would like working with computer technology.	1	2	3	4	5
8.	A job using computer technology would be very interesting.	1	2	3	4	5
9.	I enjoy computer work.	1	2	3	4	5
10.	If given the opportunity, I would like to learn about computer technology.	1	2	3	4	5
11.	Working with computer technology makes me feel tense and uncomfortable.	1	2	3	4	5
12.	Working with computer would make me very nervous.	1	2	3	4	5
13.	Computer technology intimidates and threatens me.	1	2	3	4	5
14.	Computer technology frustrates me.	1	2	3	4	5
15.	I sometimes get nervous just thinking about computer technology.	1	2	3	4	5
16.	I feel apprehensive about using computer technology.	1	2	3	4	5
17.	Computer technology would help me organize my work.	1	2	3	4	5
18.	Computer technology solves more problems than it causes.	1	2	3	4	5
19.	Computer technology helps provide a better learning experience.	1	2	3	4	5
20.	Computer technology makes the course more interesting.	1	2	3	4	5
21.	There is so much curriculum content to cover that the use of computer technology would be a waste of time.	1	2	3	4	5
22.	Computer Technology is an effective tool for teaching mathematics.	1	2	3	4	5
23.	Computer technology could enhance remedial instruction in mathematics.	1	2	3	4	5
24.	Computer technology will relieve teachers of routine duties.	1	2	3	4	5

SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree

		SD	D	U	A	SA
25.	Computer technology can be used successfully with mathematical problems which demand creative activities.	1	2	3	4	5
26.	Computer technology can be a useful instructional aid in mathematics.	1	2	3	4	5
27.	The use of computer technology in math education almost always reduces the personal treatment of students.	1	2	3	4	5
28.	Computer technology should be used to disseminate class information and assignments.	1	2	3	4	5
29.	Computer technology provides better access to real life applications.	1	2	3	4	5
30.	The use of computer technology allows a teacher to explore important questions and issues arising out of the mathematical content.	1	2	3	4	5
31.	The use of computer technology allows students to explore challenging mathematical contents.	1	2	3	4	5
32.	The use of computer technology allows the teacher to introduce synthesis and analysis into the mathematical content to be learned.	1	2	3	4	5
33.	Computer technology will make a teacher lose authority in the classroom.	1	2	3	4	5
34.	Computer technology is an extra load for teachers.	1	2	3	4	5
35.	Computer technology will change the teachers' role in the classroom.	1	2	3	4	5
36.	Computer technology will replace teachers.	1	2	3	4	5
37.	I have a lot of self-confidence when it comes to working with computer technology.	1	2	3	4	5
38.	Learning to use computer technology is like learning any new skill - the more you practice, the better you become.	1	2	3	4	5
39.	Knowing how to use computer technology is a worthwhile skill.	1	2	3	4	5
40.	Preparing a test using computer technology would scare me.	1	2	3	4	5
41.	Teacher training of mathematics should include instructional applications of computer technology.	1	2	3	4	5
42.	Computer technology would increase my productivity.	1	2	3	4	5
43.	Computer technology would save me time.	1	2	3	4	5
44.	Computer technology would help me learn better the content as well as other methods of teaching.	1	2	3	4	5
45.	The use of computer technology creates more interaction between student and teacher.	1	2	3	4	5
46.	I see technology as something I will rarely use in my daily life as an adult.	1	2	3	4	5
47.	Computer technology would motivate students in mathematics classes.	1	2	3	4	5

SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree

		SD	D	U	A	SA
48.	Computer technology would significantly improve the overall quality of my students' education.	1	2	3	4	5
49.	Computer technology would help students improve their problem solving skills.	1	2	3	4	5
50.	Computer technology would stimulate creativity in students.	1	2	3	4	5
51.	Computer technology would help students work with one another.	1	2	3	4	5
52.	Computer technology would help me as a mathematics teacher to open new horizons for students.	1	2	3	4	5
53.	Computer technology makes the student feel more involved.	1	2	3	4	5
54.	Computer technology helps the student to learn better.	1	2	3	4	5
55.	Computer technology increases motivation for the course.	1	2	3	4	5
56.	Computer technology creates more interaction between students.	1	2	3	4	5
57.	Computer technology allows students to do their own thinking, build their own answers and interpret information.	1	2	3	4	5
58.	Computer technology helps students with special educational needs improve their understanding of mathematical concepts.	1	2	3	4	5
59.	Computer technology helps simplify material and accelerate understanding for students of special needs.	1	2	3	4	5

Please include additional comments below.

Thank you for your time.

APPENDIX B

Thank You Letter

Dear Colleague,

Last month a survey about attitudes of Middle School Mathematics teachers towards integrating computer technology in their teaching and their beliefs about its effect on their effectiveness in class was placed in your school mailbox. If you have already returned your completed questionnaire, please accept my sincere thanks. If not, please take the time to answer the questions and return it to me within the next week. It is extremely important that your opinions be included in this study. If you did not receive the questionnaire or it has been misplaced, please e-mail me back at narouni@hotmail.com. or call me at home 961-07-721042 and I will get a copy of the questionnaire to you.

Thank you once again for your time.

Your Colleague,

Nazmieh Arouni

LAU- Program of Master in Education

APPENDIX C

Interview questions

I- What kinds of things do you regularly use computer technology for?

II- List the obstacles that you (might) have faced as a teacher as you tried to integrate computer technology into your teaching practices? And describe your worst experience with technology.

III- What kind of changes in your students' understanding or your classroom techniques can you expect or report that are due to computer technology?

IV- Do you believe that teachers who use technology are better teachers?

V- In your opinion, what are the most important recommendations for integrating computer technology in mathematics classrooms?

APPENDIX D

Codes of Interviews

Coded Categories and Subcategories	Codes
Factors behind teachers' attitudes	A
Teacher Time Issues	AT
Access	AA
Support issues	AS
Administrative Support (Teacher Training)	ASA
Financial Support	ASF
Technical Support (Trouble-shooting)	AST
Planning	AP
Knowledge level	AK
Confidence level	AC
Teachers' beliefs regarding the impact of integrating computer technology on:	B
The type of mathematical content they teach	BC
Their pedagogical skills	BP
Their ability to adapt the curriculum to their students' needs.	BA

Teachers' attitudes

Teacher Time Issues (AT)

- Using technology in teaching is something that takes time and requires practice

- I had problems with scheduling enough computer time to fit into my teaching hours and to satisfy the needs of computer integration
- I was overloaded with teaching hours, work and correction
- Planning technology lessons was frustrating and time consuming for me
- The time required to plan and develop new technology lessons made me feel as if I am a first-year teacher working through new material or curriculum.
- technology is moving quickly and often faster than teachers and I have no time to catch up
- I spend less time lecturing to the entire class

Access (AA)

- Our school had too few computers for the number of students
- Our school does not have a computer lab- we barely had a few computers that students have to share.
- Access to computers must be possible. Many teachers do not have the opportunity to use computer technology in their classrooms
- Availability of hardware and software is for me the utmost.

Support Issues (AS)

Administrative (ASA)

- my coordinator and the principal supported me excellently
- I hope that our school had courses to train us more on the use of computers to teach the students mathematics.

- Schools must work toward supporting and promoting change in teaching roles and practice that use new technologies.
- Teacher training is a must.
- The majority of teachers seem to need encouragement, modeling, and technical training to infuse technology into their daily teaching strategies.
- There must be a general policy all around the country that supports this integration of computer technology in mathematics classrooms.
- The principal, coordinator, parents' committee along with the whole administration should support and encourage teachers in all ways possible as they incorporate computer technology into their classrooms
- Teachers should change their attitudes and try to adapt themselves with any new innovation especially technology. I just think that teachers have to be ready to use technology in the classroom
- Workshops would be beneficial, but even workshops alone would not be enough to get teachers started using technology. Teachers have to be ready to make a change.

Financial (ASF)

- Inadequate financial support (use of computers needs software that the school was not ready to pay for).
- It was not possible to run a new software since the computer was a very old one and it can not run it
- I hope that our school had more advanced computers
- Teachers do not have the opportunity to use computer technology in their classrooms because the school is not adequately equipped with computers.
- Availability of hardware and software is for me the utmost.

- The expense of frequent upgrades might prohibit the schools from replacing the computers and software that they had to work with very often.

Technical (AST)

- I did not have enough help for supervising student use of computers (no lab assistant)
- I feel embarrassed if I could not trouble-shoot a problem in front of my students.
- I had my whole lesson prepared on a CD and it did not open. I had to change my lesson plan for that day and improvise a new lesson
- One day I was not knowing how to work something out on excel in the class, and my student guided me on how to do it
- the electricity in school went out while we were doing our lesson using a computer software, and the whole hour was ruined
- The computer froze when I was teaching the students a new lesson
- we have an IT department at school that is there to help us with any problems

Planning (AP)

- Planning technology lessons was frustrating and time consuming for me
- I once took some extra material off the internet and gave it as a quiz; one of my worst students got a 100 on it. It turned out that his private teacher had done the same and they practiced these as exercises at home.
- I feel that if the technology lessons were well designed and planned, the classroom management while using the technology lesson would be easier than on a traditional teaching day.
- I feel that deciding when technology is the best teaching tool to use is also important

- Anything new is better, especially if the teacher uses a quality software and not one for just drill and practice
- Teachers who can match technology use to the objectives of the new curriculum are much better than those still using traditional methods of teaching.
- Using technology appropriately and not just to use it for all instructional objectives is an important consideration that teachers must consider when deciding whether to use technology as part of an instructional strategy.

Knowledge Level (AK)

- I had spent three hours preparing and typing an exam on my PC at home; I forgot to save it
- I think that good teachers are those who know the material well not those who know how to open or close a computer. Computer technology will add nothing to such teachers.
- Our teachers were applying the traditional curriculum where technology was absent and they were great. They do not know and never knew how to put a computer on or off.
- Teachers are always taking a risk since technology is still kind of new and there are so many new things out there and they're always changing and they're afraid that they'll do something and it'll be outdated next week.

Confidence Level (AC)

- The time required to plan and develop new technology lessons made me feel as if I am a first-year teacher working through new material or curriculum.
- Technology is moving quickly and I feel embarrassed if I could not trouble-shoot a problem in front of my students.

- I am more comfortable with students working independently. Exploration makes them appreciate mathematics and gives it new meanings
- I had no bad experiences with the computer; it is fun to work with
- Computers add to the skills of teachers and of course they make them better
- I believe that teachers who use technology are more up to date; this is the type of people who always seek to improve themselves and thus they are better teachers.
- Teachers who can match technology use to the objectives of the new curriculum are much better than those still using traditional methods of teaching.
- Teachers are always taking a risk since technology is still kind of new and there are so many new things out there and they're always changing and they're afraid that they'll do something and it'll be outdated next week.
- Teachers have to be ready to make a change.

Teachers' beliefs regarding the impact of integrating computer technology on:

The type of mathematical content they teach (EC)

- I can expect more from my students in terms of their pursuing and editing their work or projects
- Changing to use technology lessons is a way to keep the students interested in learning the content material.
- Exploration makes students appreciate mathematics and gives it new meanings.
- I am better able to present more complex material to my students
- I think that good teachers are those who know the material well not those who know how to open or close a computer. Computer technology will add nothing to such teachers.

Their pedagogical skills (EP)

- I am better able to present more complex material to my students

- I spend less time lecturing to the entire class. This makes me a facilitator than a primary instructor
- I do not just write the solution of a problem on the board. I let them work on their computers and explore the problems and find their own solutions then discuss their results and this stimulates creativity.
- Computers add to the skills of teachers and of course they make them better

Their ability to adapt the curriculum to their students' needs (EA)

- I can spend more time with individual students to work with them on the computers
- I try to focus on different ways of teaching to bring in all of the tools, to help students learn. Kids learn by different modes and they seem to be so much more excited about sitting down at a computer than maybe sitting down with a paper and pencil to learn something new or maybe just for a review.
- I feel that technology helps me teach to the different learning styles of students in my classes
- I am better able to tailor instruction to individual student needs.